Stillwater River and Rosebud Creek Flood Hazard Analyses

Stillwater County

Montana

Soil Conservation Service
U.S. Department of Agriculture
MAY 1974

Ley

Many centu their home in the beautifu ibe an Indian maiden was born, on). She was a beautiful gir made known she could take laim her hand, and jealo til a mild form of warfare

As the day Then came the day her dec d marry Nemidji, a stal hated by his fellow tribesme marksmanship, his powerful bu de him the finest hunter o

The weddin he spring. The young brave en the first snow came, stole all the food, robes, spears, and arrows. Desperation reigned. How could the old men, the squaws, and papooses hope to live during the winter without food, clothing, or beds?

Weeluna proposed a hunting trip by the girls of the camp, but none were willing to face the hardships of the winter storm. Together, Weeluna and Nemidji left camp in search of game. After three days of searching they found a herd of elk floundering in the snow. This provided the camp with supplies for the winter. Weeluna became ill from the hunt and died in the spring. They placed her body in a fir tree near the river. Night came and with it a raging storm. It washed a large amount of earth and debris, including the fir tree Weeluna was in, into the river, causing a large still pool to be formed. In the pool, the body of Weeluna could be seen drifting. The grieving Nemidji saw it and sprang into the pool to rescue the haunting remains of his beloved. Just as he reached the body and turned toward shore again, the huge wall of debris gave way and with a wild rush the wall of water engulfed the two--Nemidji being swirled away with his sweetheart tightly clasped in his arms.

When the waters receded, there remained a portion of the stream where the waters were riffleless. The tribe called this the hallowed place, Stillwater, which is the name we use for the river today. 1/

1/ Annin, Jim, They Gazed On The Beartooths, Vol. 11, Reporter Printing and Supply Co. 1964

UNITED STATES
DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
Bozeman, Montana

Report of
STILLWATER RIVER
AND ROSEBUD CREEK
FLOOD HAZARD ANALYSES

Stillwater County, Montana

Prepared in cooperation with
Montana Department of Natural Resources and Conservation
Beartooth Resource Conservation and Development Project
Stillwater County Conservation District
Stillwater County

May 1974

USDA-SCS-PORTLAND, OREG. 1974

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STILLWATER RIVER AND ROSEBUD CREEK FLOOD HAZARD ANALYSES

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INTRODUCTION

Flooding results in loss of property, creates health and safety hazards, and disrupts needed services. Flooding also results in high costs to city, county, state, and federal governments, and welfare agencies to repair or replace roads, streets, bridges, rescue and care for the stranded, protect private property, clean up debris, and restore services. These costs are of great concern to all tax-paying citizens, as well as the private landowner. As more and more construction is allowed on flood plains, without regard for threats to health and safety as posed by the potential flooding hazard, the public costs for future floods will go higher. Knowledge of potential flood hazard, as presented in this report, is the basis for properly administering a flood plain management program to minimize these costs.

Flood hazard analyses are carried out by the Soil Conservation Service as an outgrowth of the recommendations in A Report by the Task Force on Federal Flood Control Policy, House Document No. 465, (89th Congress--August 10, 1966), especially Recommendation 9(c), "Regulation of Land Use," which recommended the preparation of preliminary reports for guidance in those areas where assistance is needed before a full flood hazard information report can be prepared or where a full report is not scheduled.

Authority for funding flood hazard analyses is provided by Section 6 of P.L. 83-566, which authorizes the U. S. Department of Agriculture to cooperate with other federal, state, and local agencies to make investigations and surveys of the watersheds of rivers and other waterways as a basis for the development of coordinated programs.

In carrying out flood hazard analyses, the Soil Conservation Service (SCS) is being responsive to Executive Order 11296 (see Appendix C), dated August 10, 1966, especially to Section 1(4), which directs that: "All executive agencies responsible for programs which entail land use planning shall take flood hazards into account when evaluating plans and shall encourage land use appropriate to the degree of hazard involved." The order also directs that all federal agencies responsible for administration of federal grants, loans, or mortgage insurance programs involving the construction of buildings, structures, roads, or other facilities to evaluate flood hazards to such facilities. The reason was to minimize potential damages and reduce future expenditures for flood protection and disaster relief. Federal agencies were also directed to require conspicuous delineation of past and probable flood heights on federally owned properties to assist in creating public awareness of, and knowledge about, flood hazards.

The Flood Disaster Protection Act of 1973 (P. L. 93-234, effective December 31, 1973) prohibits, as of March 2, 1974, direct or indirect Federal financial assistance, including that from lending institutions, for the acquisition, construction, repair or improvement of any building or mobile home within any area previously identified by HUD as having special flood hazards (subject to inundation by a 100-year frequency flood) and for which flood insurance is available, unless the federally-assisted owner or occupier carries flood insurance on the building or mobile home and contents in an amount equal to the Federal investment or to the maximum limit of insurance coverage available, whichever is less, for the anticipated economic or useful life of the building or mobile home.

Effective July 1, 1975, the Act prohibits Federal financial assistance for the acquisition, construction, repair or improvement of any building or mobile home in any area identified by HUD as having special flood hazards, unless the community in which such area is located is then participating in the national flood insurance program.

In 1971 the Montana Legislature passed legislation to ease the increasing problem of flood loss and damage in Montana. This act was revised by the 1973 and 1974 Legislature. The Montana Floodway Management and Regulation Act, title 89, chapter 35, Revised Code of Montana, as revised by House Bill 924, authorizes the Montana Department of Natural Resources and Conservation to initiate a comprehensive program of floodway delineation and regulation for the entire state. (See Appendix C.) The purpose of this state-wide flood plain policy is two-fold:

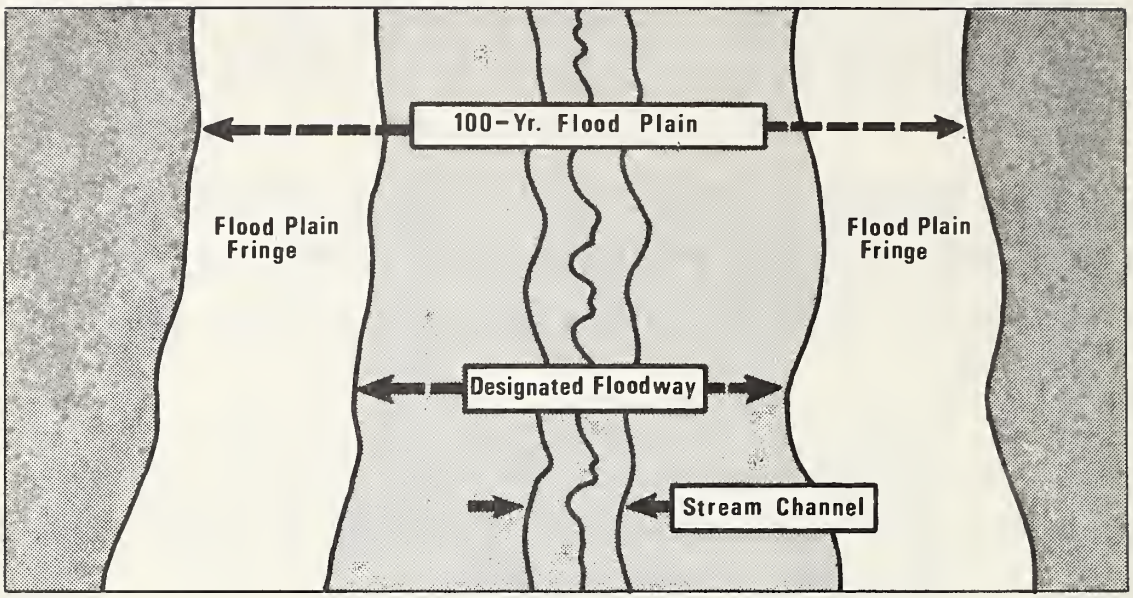
1. To eliminate or minimize loss of life, personal suffering, and physical hardships which are immediate consequences of serious floods.
2. To achieve the optimum beneficial use of our flood plains for both private and public benefits.

Many land uses are compatible with periodic flooding and are permitted within the designated floodway (see figure 1) to the extent that they are not prohibited by any other statute. Some "open space" uses specifically allowed within the designated floodway are agricultural uses, industrial and commercial uses such as loading areas or parking areas, and open-type public and private recreation areas. In addition, other land uses, including buildings for living purposes or commercial structures and excavations, may be allowed on the flood plain fringe provided they are adequately floodproofed.

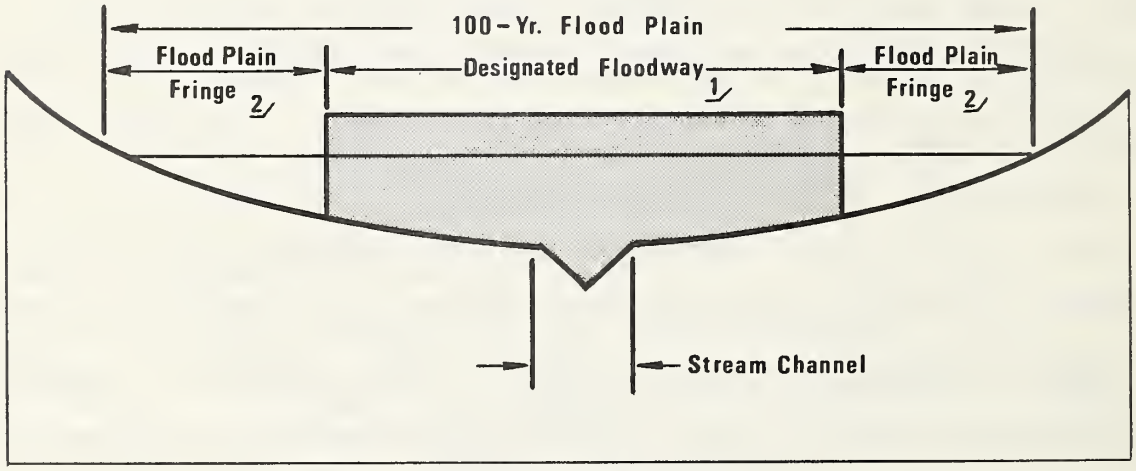
Specific recommendations on acceptable flood plain land uses and State standards for flood plain development will be furnished to the Stillwater County Conservation District and the Stillwater County Commissioners by the Soil Conservation Service and the Montana Department of Natural Resources and Conservation.

Figure 1

FLOOD HAZARD AREAS



PLAN VIEW



CROSS SECTION

1/ DESIGNATED FLOODWAY is the adjusted portions of the 100-year flood plain allowing for an acceptable increase in the 100-year flood height, no building or fill permitted.

2/ FLOOD PLAIN FRINGE--Urban use permitted if protected by fill, floodproofed, or otherwise protected.

Flood hazards increase in developing areas. Urbanization means new homes, schools, businesses, streets, and less exposed soil to absorb precipitation, therefore, more storm runoff. Pavements, roofs, compacted soil, and storm sewers all increase and speed up the runoff, increasing the flood hazard locally and downstream.

Various land uses in a developing area compete for each parcel of land. Flood plain lands are no exception. Encroachments into the flood plain by land filling, railroads, highways, channel modification, and other developments constrict the flow of floodwater. These constrictions increase floodwater depths and velocities.

Managers and users of flood plain land should base their use decisions upon the advantages and disadvantages of locating within flood hazard areas. Knowledge of the hazards involved is not widespread and, consequently, managers, potential users, and occupants cannot always accurately assess the risks.

In order for flood plain management to effectively play its role in the development of flood plains, it is necessary to:

1. Provide state and local units of government with appropriate technical information and interpretations for use in flood plain management.
2. Provide technical services to managers of flood plain property to better coordinate planning for development and appropriate land use.
3. Improve basic technical knowledge about flood plain hazards in cooperation with other agencies and groups.

4. Provide conspicuous delineation of past and probable flood heights in order to protect potential future tenants or purchasers of flood plain property from unscrupulous landlords and real estate developers. See Plate 1.

This report contains sixteen (16) aerial photomaps showing the 100-year frequency flood lines along a portion of the Stillwater River and Rosebud Creek. The photomaps also show soils information. Water surface profiles, soils interpretations, flood photographs, and other related flood plain data are included in this report.

The 10-, 25-, 50-, 100-, and 500-year frequency floods were analyzed. A 50-year frequency flood has an average occurrence of once in 50 years or a two percent chance of occurring in any given year. A 100-year flood occurs once in 100 years on the average or has a one percent chance of occurring in any given year. Only the 100-year flood lines are shown on the aerial photomaps and water surface profiles. Information for the 10-, 25-, 50-, 100-, and 500-year floods are shown in flood plain reference tables. Elevations for other frequency storms can be determined from the basic support data on file with the Soil Conservation Service.

DESCRIPTION OF THE WATERSHED

The Stillwater River Watershed is located in southcentral Montana. The river has 1,057 square miles of drainage area--71.5 percent in

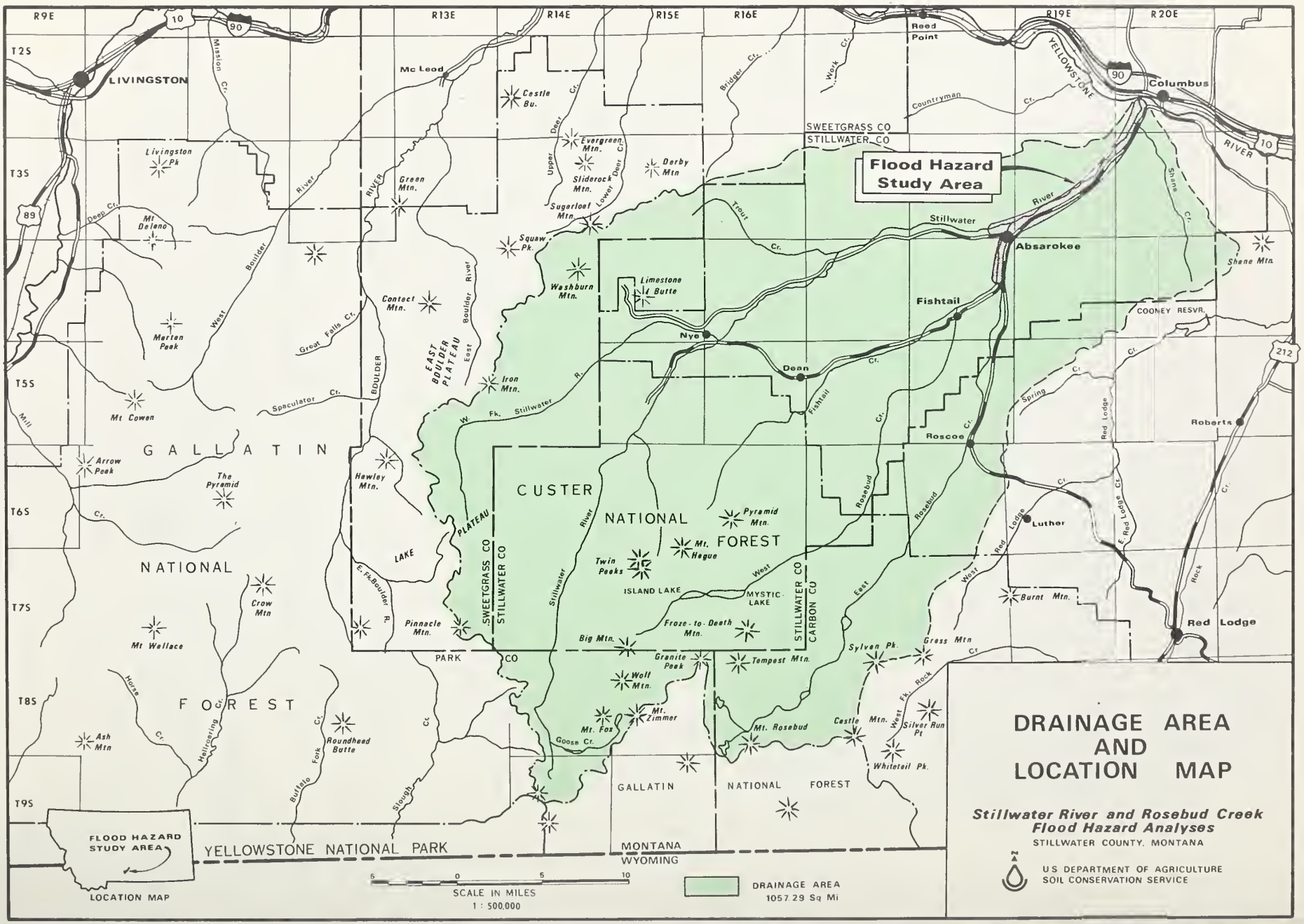
Stillwater County; 1.4 percent in Park County; 25.4 percent in Carbon Carbon County; and 1.7 percent in Sweet Grass County. (See watershed map, page 8.) The stream heads at the northeast corner of Yellowstone National Park near the Montana-Wyoming border in the Beartooth Mountains. The Stillwater River main stem flows north-northeast to Nye and then generally northeast to Columbus where it empties into the Yellowstone River.

East Rosebud Creek and West Rosebud Creek are the largest tributaries of the Stillwater River. They also head in the Beartooth Mountains and flow generally northeast to a point three miles south of Absarokee. Here they form Rosebud Creek. Rosebud Creek flows north for four miles, through Absarokee, and into the Stillwater River.

The topography of the area varies from very rugged mountains to smooth valley bottoms. The elevation of the highest point in the watershed, also the highest point in Montana, is Granite Peak, 12,799 feet mean sea level (msl), and the lowest is at the Yellowstone River, 3,588 feet msl, approximately one mile west of Columbus.

Approximately one-half of the drainage area is in the rugged Beartooth Mountains. Much of the area is above timberline and consists of jagged peaks and basins formed by recent glaciers. There are many small glacial lakes in this area.

The remainder of the watershed is rolling plains and foothill country. Land use in this portion of the watershed is primarily rangeland. In the valley bottoms the land use is primarily irrigated hayland and pasture. There is very little cultivated cropping in the watershed.



DRAINAGE AREA AND LOCATION MAP

Stillwater River and Rosebud Creek Flood Hazard Analyses

STILLWATER COUNTY, MONTANA

US DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

RIVER BASIN AND WATERSHED PLANNING PARTY BOZEMAN MONTANA

Annual precipitation varies between 70 inches in the mountains to 12-14 inches at the Yellowstone River. Much of the precipitation in the higher elevations falls as snow. Snow remains on some of the mountain peaks year-round. Accumulations have been measured to depths exceeding 20 feet, but the normal is 10-12 feet on the Beartooth plateau. The melting of this snowpack during late spring and early summer contributes to the high volume of runoff in the Stillwater River drainage.

The area was once part of the Crow Indian Reservation, but was opened to homesteading by treaty in 1892. Mining of gold, silver, copper, nickel, and chrome was started in 1875; it is relatively inactive at present.

DESCRIPTION OF THE STUDY AREA

The study area encompasses the Stillwater River flood plain between the Yellowstone River and the Johnson Bridge west of Absarokee, Rosebud Creek flood plain between the junction of East and West Rosebud Creeks, and the confluence of Rosebud Creek and the Stillwater River. (See map, page 8.)

Land use in the study area is primarily irrigated hayland and pastureland. Another land use is recreational home sites. These sites are generally near or on the streambank. The Stillwater River and Rosebud Creek have an abundance of water to supply all irrigation needs.

Evidence of over-irrigation, ditch seepage, and poor irrigation methods is prevalent. These areas are at the foot of slope breaks and lower areas in the flood plain. These wetlands are common in the study area.

At least thirteen private and corporate irrigation ditches have their point of diversion in the study area or carry water into the study area by direct diversions from upstream.

The Stillwater River and Rosebud Creek are torrential-type streams. Velocities exceeding 5-6 feet per second are common. The channel gradient varies from 0.6-1.0 foot per 100 feet. The channel bottom is generally covered with cobbles and boulders 3 to 18 inches in diameter. Finer materials move swiftly downstream and are seldom deposited in the stream channel. Scouring associated with these velocities cause serious channel changing problems when ice jams or debris piles are encountered in the stream channel. See plate 4.

The Montana Department of Fish and Game has established four public fishing access sites in the study area. These sites offer access to the stream and provide opportunity for hiking, camping, picnicking, bird-watching, and nature study.

Wildlife species occurring in the area include mule and white-tailed deer, moose, black bear, fox, coyotes, rabbits, beaver, mink, blue and ruffed grouse, and ringed-neck pheasant, a variety of ducks, and numerous song birds.

PLATE 1

JUNE 15, 1967 70-YEAR FREQUENCY FLOOD SCS PHOTO

Many summer homes have been built in a flood plain area that is frequently flooded. Compare photo above with later photo below. Many buyers of flood plain property are often unaware of these hazards.

NOVEMBER 1973 SCS PHOTO MT-R-2-1

PLATE 2

JUNE 1970 25-YEAR FREQUENCY FLOOD SCS PHOTO

Kem-Mulherin headgate and two summer homes were damaged by the flood in June 1970.

JUNE 15, 1967 70-YEAR FREQUENCY FLOOD SCS PHOTO

Floods damage farm buildings and fences in the flood plain, outside the main channel. Deposition of river bedload and debris require costly cleanup.

OCTOBER 1973 SCS PHOTO MT-R-2-2

OCTOBER 1973 SCS PHOTO MT-R-2-3

Open space use for agriculture and recreation are compatible for flood-prone areas.

OCTOBER 1973 SCS PHOTO MT-R-2-4

PLATE 4

SEPTEMBER 1973 SCS PHOTO MT-R-2-16

This bridge was destroyed during the June 1958 flood. Damage to roads and bridges is often increased by other developments in the flood plain.

SEPTEMBER 1973 SCS PHOTO MT-R-2-17

Flood flows normally move large quantities of bedload and debris. A floodplain should have adequate area to accomodate the moving river.

PLATE 5

AUGUST 1973 SCS PHOTO MT-R-2-7

Car bodies used as bank protection are unsightly and often create more problems than they solve.

JUNE 1973 SCS PHOTO

Temporary gravel dikes in rivers can cause channel changes, accelerate erosion, and degrade fisheries.

PLATE 6

JUNE 1967 70-YEAR FREQUENCY FLOOD SCS PHOTO

Economic flood losses such as shown can be avoided by proper flood plain management. In addition, two summer homes were washed away and several others damaged by this flood.

JUNE 1967 70-YEAR FREQUENCY FLOOD SCS PHOTO

PLATE 7

OCTOBER 1973 SCS PHOTO MT-R-2-9

The Stillwater River is recognized for its statewide fishery value.

OCTOBER 1973 SCS PHOTO MT-R-2-10

Flood plain areas support valuable habitat for a variety of birds and mammals.

OCTOBER 1973 SCS PHOTO MT-R-2-11

JUNE 1967 COLUMBUS NEWS PHOTO

Emergency flood protection measures are costly in man hours, equipment and materials and are often ineffective.

JUNE 1967 COLUMBUS NEWS PHOTO

JUNE 1967 70-YEAR FREQUENCY FLOOD MRS. MART PARKER PHOTO

Flooding results in loss of property, creates health and safety hazards, and disrupts needed services.

SEPTEMBER 1973 SCS PHOTO MT-R-2-12

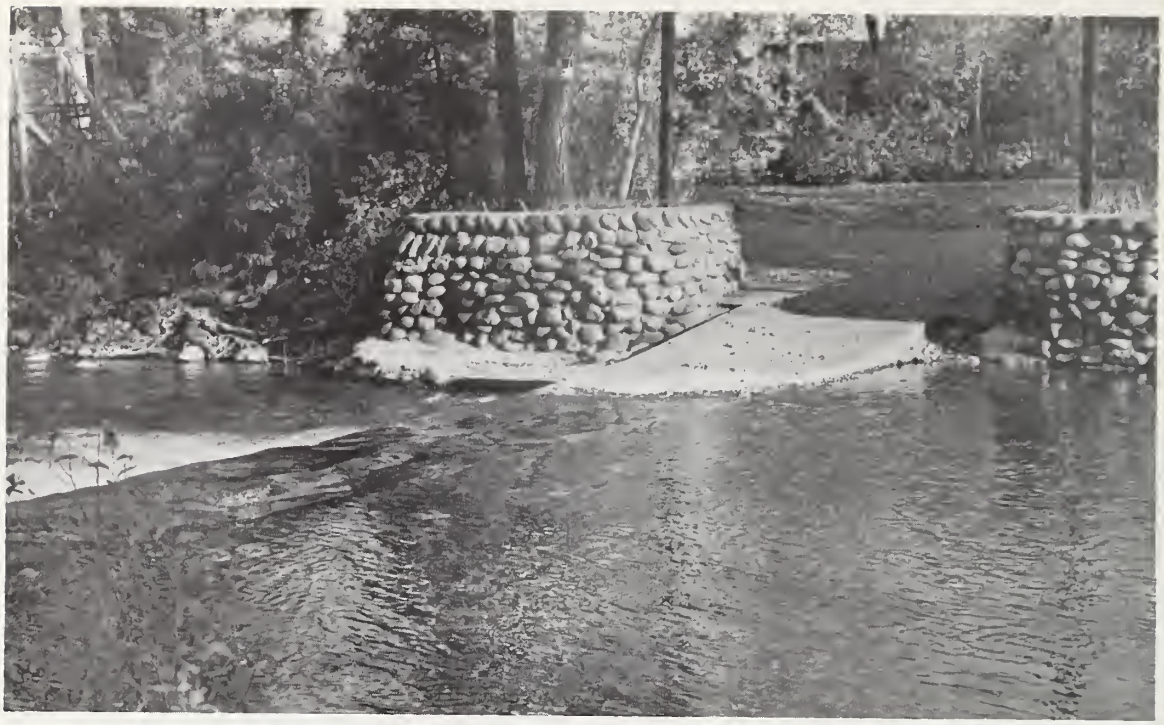
Flood proofing is expensive and often inadequate protection against large floods

SEPTEMBER 1973 SCS PHOTO MT-R-2-13

SEPTEMBER 1973 SCS PHOTO MT-R-2-14

Rock riprap provides effective river bank protection when properly designed and installed.

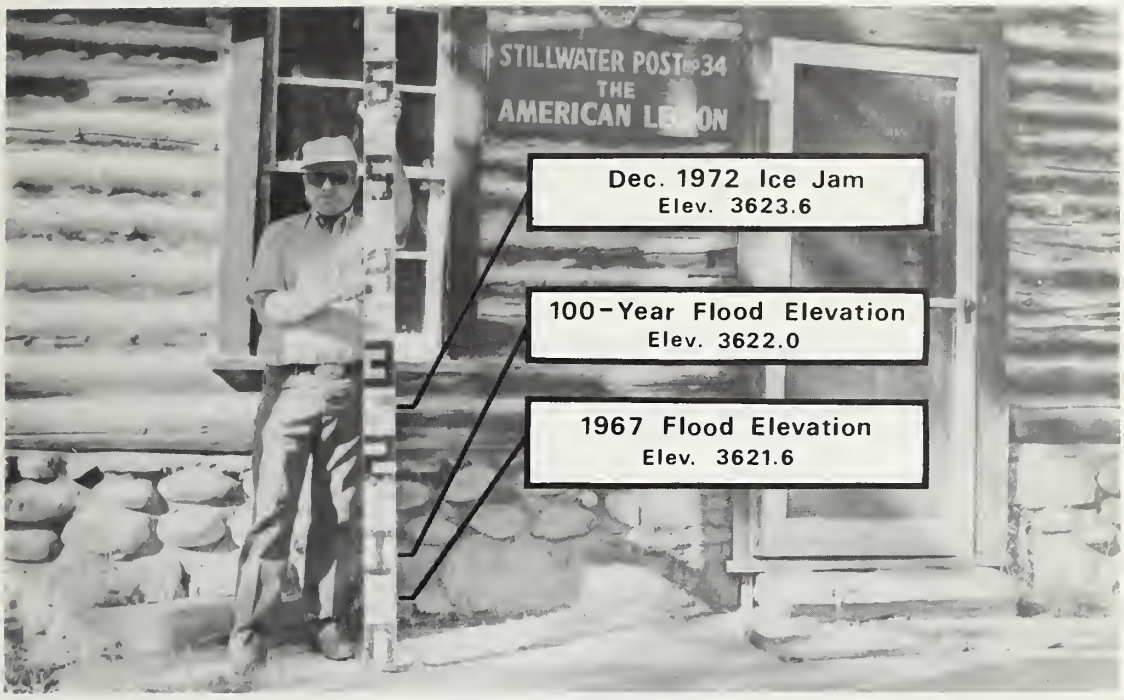
PLATE 10



SEPTEMBER 1973 SCS PHOTO MT-R-2-15

This crossing is used during low flows as shown above. Below, the same facility is seen under flooded conditions. Developments in flood hazard areas should be discouraged.

JUNE 15, 1967 70-YEAR FREQUENCY FLOOD SCS PHOTO



SEPTEMBER 1973 SCS PHOTO

Photo above compares recent high water levels with 100-year frequency flood level.

JUNE 15, 1967 SCS PHOTO 70-YEAR FREQUENCY FLOOD

Floodwater threatens the American Legion building near Firemans Point bridge.

Ice jams pose special problems along the Stillwater River. In December 1972 ice and water exceeded the 100-year frequency flood level.

SCS PHOTO

FLOODWATER PROBLEMS

The main flooding problem is caused by encroachment on the flood plain by residential construction, farm buildings and fences, irrigation diversions, dikes, and roads. The area of greatest potential damage is the town of Absarokee.

The town of Absarokee lies partially in the Rosebud Creek flood plain. Several houses on the west side of town are subject to flooding. Sheep Creek (local name) is also a source of flooding in town. This creek heads near the main channel of Rosebud Creek. Flood flows in Sheep Creek are increased by water from the old stream channels which converge near the football field. Flooding in Absarokee from Sheep Creek could be corrected by floodproofing measures. On the north side of county route 420 several more houses are subject to flooding along with a portion of the rodeo grounds, swimming pool area, and the town sewage lagoons. The lagoons and the swimming pool have been built up so that the facilities are well above the 100-year flood level, but both of these systems could be subject to flood damage from erosion of the surrounding embankments.

Many recreational and year-round homes are built on the river flood plain. Some are inundated by any high water; others are well above the 100-year flood level. Ice jams are a common occurrence in localized areas along the Stillwater and Rosebud rivers during the winter. These jams and the resulting ponding pose a special problem to these home sites since this water will, in many cases, exceed the 100-year flood level. See plate 11.

Recreational land development and some overgrazing have resulted in degradation and loss of fish and wildlife habitat along streams in the study area. Such intrusion of the flood plain has required the expenditure of considerable local and federal funds to protect developments that are subject to occasional water inundation, sedimentation, and erosion.

Several miles of stream channel in the study area have been modified through channel straightening and other channel modifications. Bulldozers have been used in the river to redirect channel flow to diversion headgates, change direction of flow, or build gravel dikes. This apparently is an annual practice. Considerable refuse and junk, car bodies, and trees have been dumped into the river. These practices disrupt and damage the stream channel.

Some irrigation ditches contribute to the flooding problem by diverting floodwater from the main channel to old channels and other low areas not necessarily in the flood plain. Not all of these areas have been delineated on the photomaps.

Flooding occurs when snowmelt is combined with rainfall in May and June. Major recorded floods in the watershed have occurred as recently as 1937, 1943, 1944, 1948, 1967, and 1970. Some floods have affected particular parts of the flood plain more than others. Mystic Lake, constructed in 1925 on West Rosebud Creek, has a storage capacity of 20,780 acre-feet. This lake has a regulating effect on the peak flows on Rosebud Creek and the Stillwater River.

SOURCES OF DATA AND METHODS OF STUDY

Basic data used in this study include topographic maps, flood-prone area maps, and streamflow records published by the U. S. Geological Survey; U. S. Coast and Geodetic Survey bench marks (BM); U. S. Forest Service (USFS) maps; Guidelines for Action, Beartooth RC&D Project, Carbon and Stillwater Counties, Montana; Absarokee, Montana, plat map; and The Columbus News. The photomaps are portions of 1970 U. S. Department of Agriculture, Agricultural Stabilization and Conservation Service aerial photographs. Other physical data were obtained from locally available maps and engineering field surveys.

The soils information in this report, taken from Soil Conservation Service Soil Survey Data of Stillwater County, is confined to the flood plain, adjacent terraces, and uplands. The valley soils are underlain by deep valley fill of relatively porous sand and gravel. Some areas have smooth surface topography, but others are very irregular and broken by old shallow stream meanders. Soil boundaries and symbols are printed in red on the photomaps. Mapping units have been identified and detailed descriptions and interpretations are found in Appendix B.

First steps in the study consisted of reviewing historical flood data, high water marks, stream gage records, flood photos and maps. The frequencies of known floods were determined by hydrological analysis of streamflow records available in the general area. Water surface profile determinations were made using historical data combined with

available SCS Automatic Data Processing programs to establish elevation-discharge relationships. Water surface profiles and delineated flood lines are based on high water marks, existing watershed cover, present flood plain use, and existing channel conditions.

The water surface profile elevation-discharge relationships were used to establish flood elevations for the various frequency events at each surveyed cross section. Photos and flood elevations of the 1967 and the 1970 floods were used as checks for the computed water surface profiles.

Engineering field surveys were made by SCS field crews. Flood lines were located between valley cross sections by stereoscopic interpretations, additional field surveys, and historical records of high water marks. Historical records were in the form of photographs, water marks, newspaper articles, and personal recollections.

Computations for this study considered only conditions in the flood plain at the time field surveys were made. Water surface profile computations at bridges are based on present normal bridge openings Consideration was not given to possible blockage of bridge openings by ice, sediment, or other debris nor any future enlargement. Flood plain filling and other encroachments also can affect the computed water surface profiles. Future flood plain and watershed development and modification will require revised water surface profile computations.

STUDY RESULTS

This flood hazard analysis is focused on developing information about the 100-year flood plain along the Stillwater River and Rosebud Creek. Much of the information is interrelated and specific data can be obtained from this report in several ways.

For information about the estimated floodwater elevation at a specific location, refer to the aerial photomaps to determine where this location is relative to the nearest upstream and downstream surveyed cross sections. Interpolation is necessary between cross sections to arrive at an estimated floodwater elevation from flood plain reference data tables, Appendix A.

Appendix A provides supplemental data and tables for: flood frequency discharges, elevations of various frequency floods, bridges, increased depth-remaining floodway widths, and information on bench marks.

Another method to determine a floodwater elevation at a specific location is to estimate the channel station near the location in question from the stations shown on the photomaps. Next, find the location of that station on the water surface profile. Read the flood elevation directly from the profile by going vertically from the station scale to the plotted 100-year flood elevation line and then horizontally to read the elevation.

The preceding methods will give flood elevations on the flood plain for all sections except those footnoted in the flood plain reference data tables. The flood plain at the footnoted cross sections has one or more old channels other than the main channel. The flow in these side channels will be of varying depths and amounts and the water surface in these instances will vary from the published data for the cross section. There are many old channels and meanders in the valley floor caused by natural and man-made channel changes. When the flow reaches flood stage, waters from the main channel overflow or are diverted into these old side channels. This overflow may follow old side channels for a considerable distance before it rejoins the main channel. This overland flow causes "islands" or isolated areas in the flood plain.

The delineated areas subject to inundation on the photomaps are general in nature and may include small areas that do not flood or vice versa.

Appendix B contains descriptions and interpretations for the soils symbols shown on the aerial photomaps. Soils data correlate with flood plain information and can be used for land use planning.

USE OF THE STUDY

This report can be used as a technical tool to help develop local flood plain land use and development regulations. It is intended to

serve as a technical basis for determining needed action to minimize flood damages and as a basis for further study and planning on the part of Stillwater County, Stillwater County Conservation District, and the Montana Department of Natural Resources and Conservation. Future action could include: local planning programs to guide developments; controlling the permitted uses of flood plains through zoning and subdivision regulations; the construction of flood protection works; or combinations of these two approaches. Such solutions could include the following nonstructural or preventive measures:

Land Use Planning
Flood Plain Control Regulations
Flood Plain Development Policies
Flood Plain Filling Regulations
Flood Plain Acquisition
Flood Plain Zoning
Upstream Land Treatment Program
Flood Warning System
Flood Insurance
Tax Adjustments
Health Regulations
Building Codes

Corrective or structural measures which would complement the preceding include:

Floodwater Retarding Reservoirs
Channel Improvement
Levees and Dikes
Pumps
Floodproofing
Watershed Treatment
Urban Relocation

The Montana Department of Natural Resources and Conservation and the Soil Conservation Service will, upon request, provide technical assistance to federal, state, and local agencies and organizations in the interpretation and use of the information developed in this study.

Flood damage prevention can only be achieved through proper recognition of the hazards associated with flood plain development. County commissioners and other responsible local officials should take the steps necessary to promote wise flood plain use in the study area. Zoning and subdivision regulations are two regulatory tools available to local officials to control and prevent unwise developments in flood prone areas. Comprehensive planning is a necessary prerequisite for zoning, and flood plain limitations are an important consideration for land use planning.

Land use planning for the flood prone areas should include the following provisions:

1. That the designated floodway be reserved for open-space uses. See page 4.
2. That residential and commercial uses be located outside the 100-year flood area or in the fringe area and be properly flood-proofed.
3. That minor structures, if permitted in flood-prone areas, be suitably anchored to prevent flotation.
4. That no use be allowed that increases the elevation of the water surface in the 100-year flood plain by more than 0.5 foot.

Table 5 indicates the amount the total flood area could be constricted to cause a 0.5-foot or 1.0-foot increase in flood elevation. These data can be used to estimate the effect of individual developments. This reduction in flood plain width is based on equal reduction in the floodway conveyance factors on both sides of the channel.

If the 100-year flood plain is narrowed, adequate structural measures should be required. Narrowing of the 100-year flood plain will increase flood depths and damages to existing property within the remaining floodway area.

An alternate to be considered would be the acquisition of flowage easements along each bank of the stream. This procedure would allow the area to pursue a long-range program of channel improvements. Nonconforming uses would be eliminated, future encroachments prevented, and channel maintenance assumed as a county and town responsibility.

The Montana Department of Natural Resources and Conservation will provide assistance to local officials considering zoning and/or subdivisions regulations to prevent flood damage.

CONTINUED OBSERVATIONS

The data presented in this report have been derived from a limited history of past flood events. Observation of future flood heights and flood quantities should be continued and the computed values checked and refined by these observations. The assistance of individuals in the flood plain is required in this future observation program. Local residents should be encouraged to make accurate observations, including photographs of flood heights on their properties. These data should be collected and reported to the local government units.

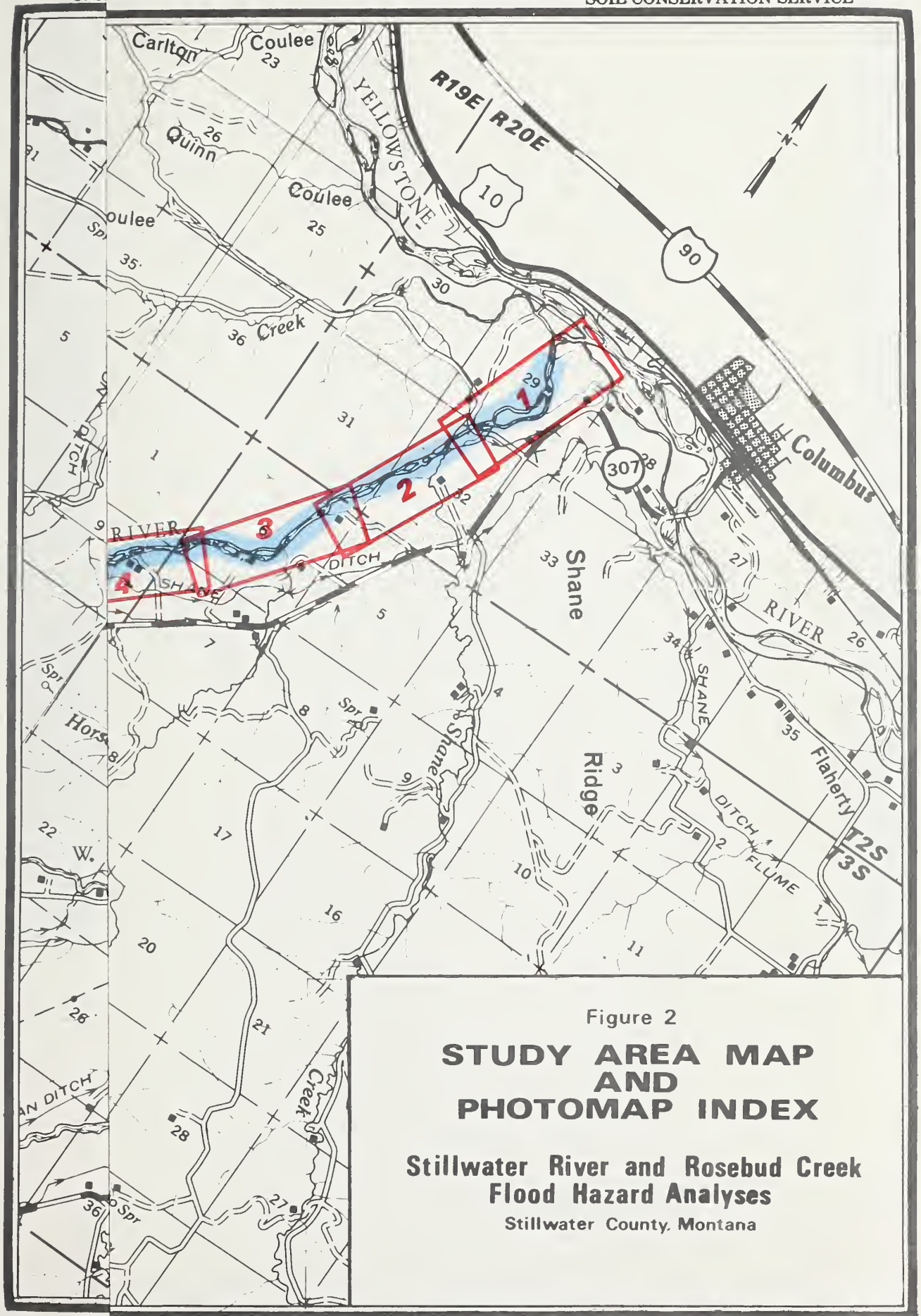
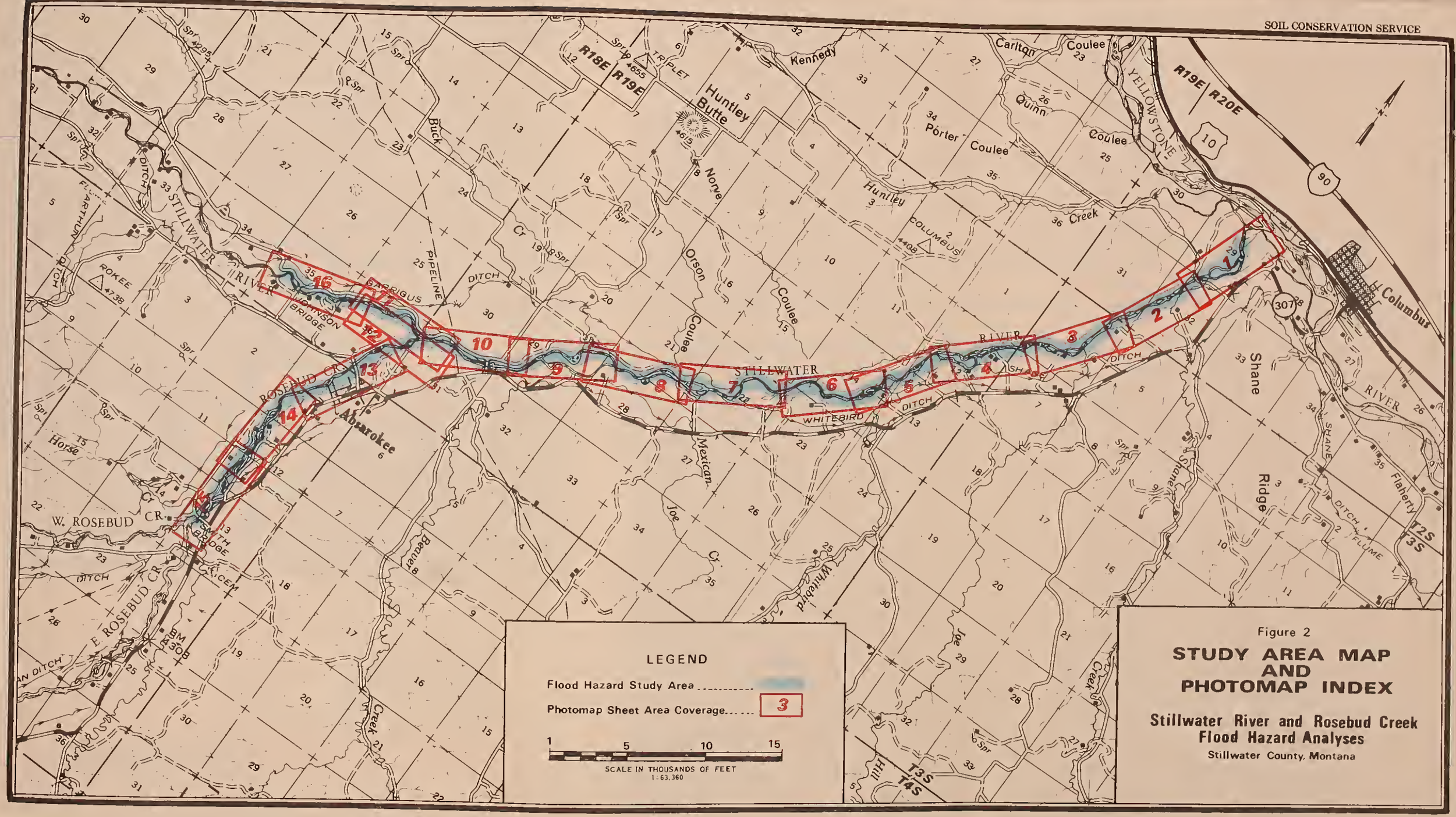


Figure 2

STUDY AREA MAP AND PHOTOMAP INDEX

Stillwater River and Rosebud Creek Flood Hazard Analyses

Stillwater County, Montana



LEGEND

Flood Hazard Study Area .....

Photomap Sheet Area Coverage..... 3

1 5 10 15

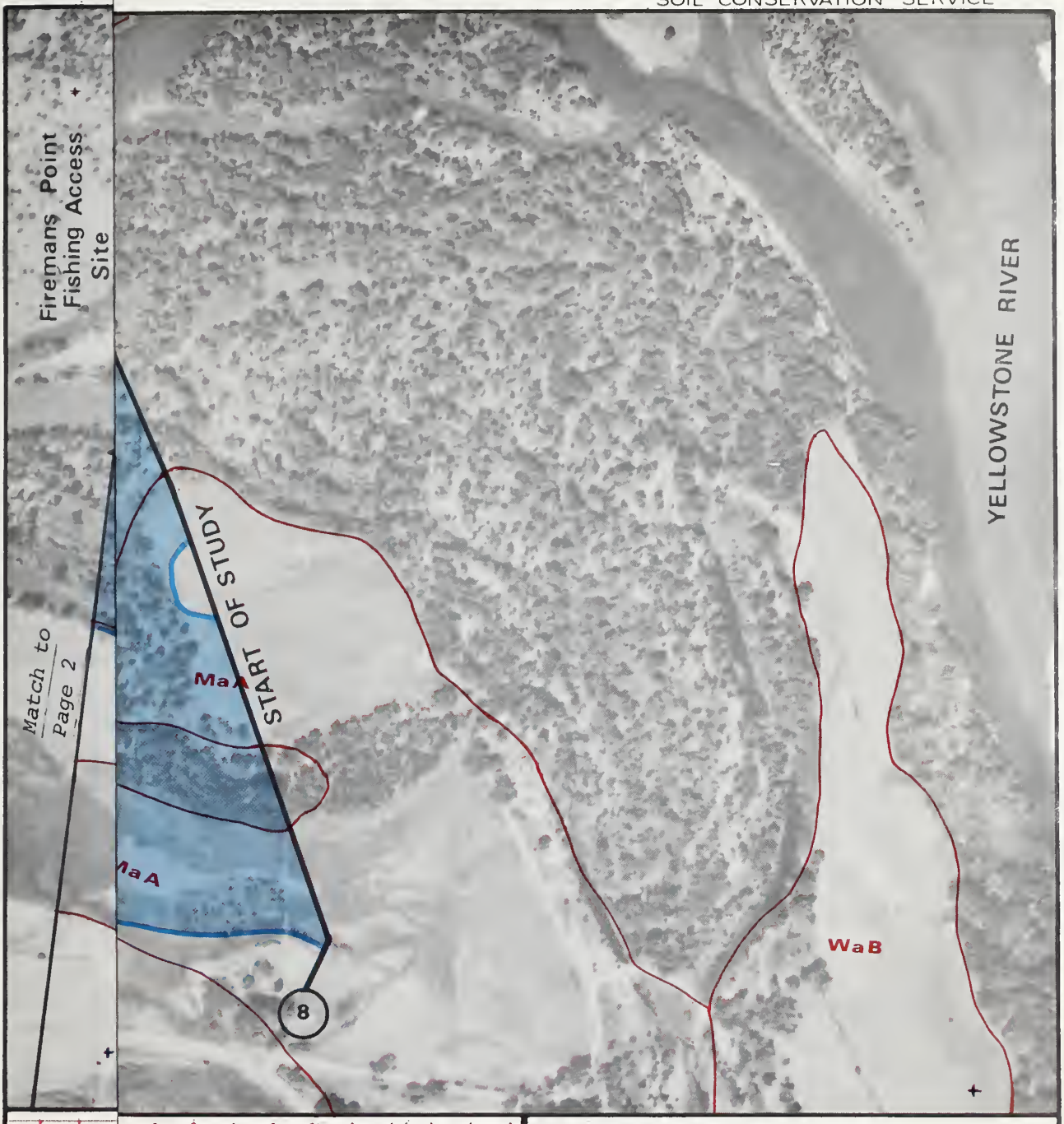
SCALE IN THOUSANDS OF FEET
1:63,360

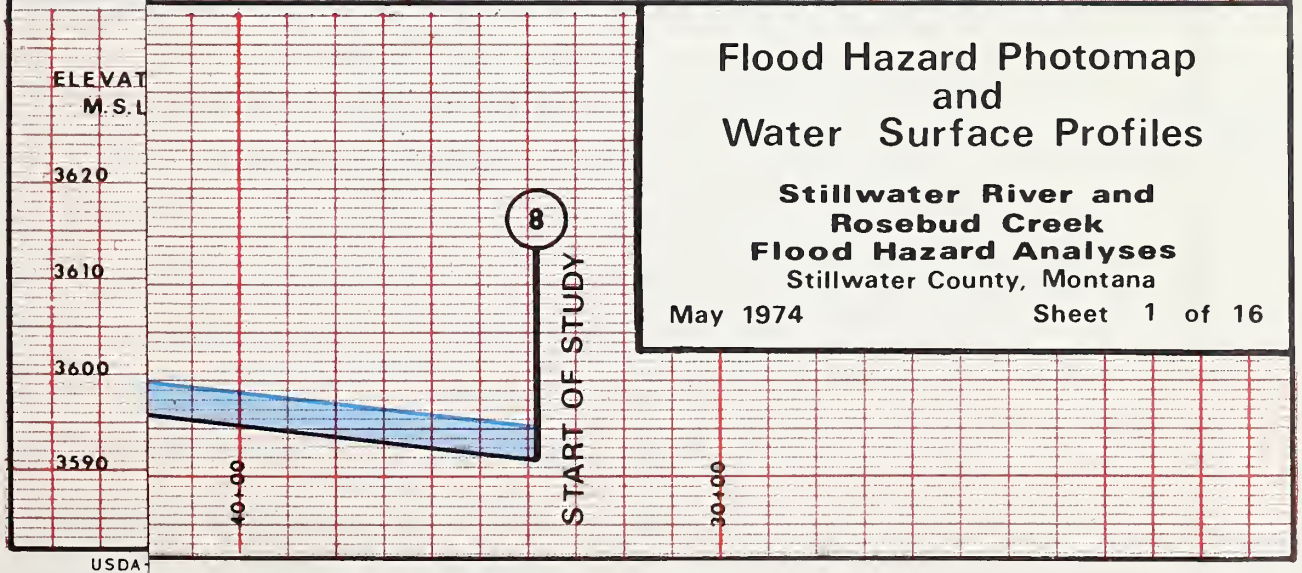
Figure 2

STUDY AREA MAP AND PHOTOMAP INDEX

Stillwater River and Rosebud Creek Flood Hazard Analyses

Stillwater County, Montana





Flood Hazard Photomap and Water Surface Profiles

Stillwater River and Rosebud Creek Flood Hazard Analyses

Stillwater County, Montana

May 1974 Sheet 1 of 16

PHOTOMAP

100-Yeer Flood Line

100-Yeer Flood Aree

Ma Soils Area Boundary and Symbol

5 Velley Cross Section

2 0 2 4 6 8

1" = 400 FEET 1:4,800

WATER SURFACE PROFILE

Cross Section Number 5

100-Year Flood Elevation

Top of Bridge Deck

Top of Bridge Opening

SCALE

Horizontal 1" = 400 Feet

Vertical 1" = 20 Feet

Firemans Point Fishing Access Site

Sec 29 Sec 32 T25 R20E

SuE

WaB

MaA

TuA

STILLWATER RIVER

START OF STUDY

YELLOWSTONE RIVER

Ma

MaA

MbA

NuA

WaB

LaB

WoC

11 12 10 9.1 9 8

Match to Page 2

N

Match to Page 2

ELEVATION M.S.L.

3620

3610

3600

3590

Water Surface Nov. 1973

CHANNEL STATIONS

START OF STUDY

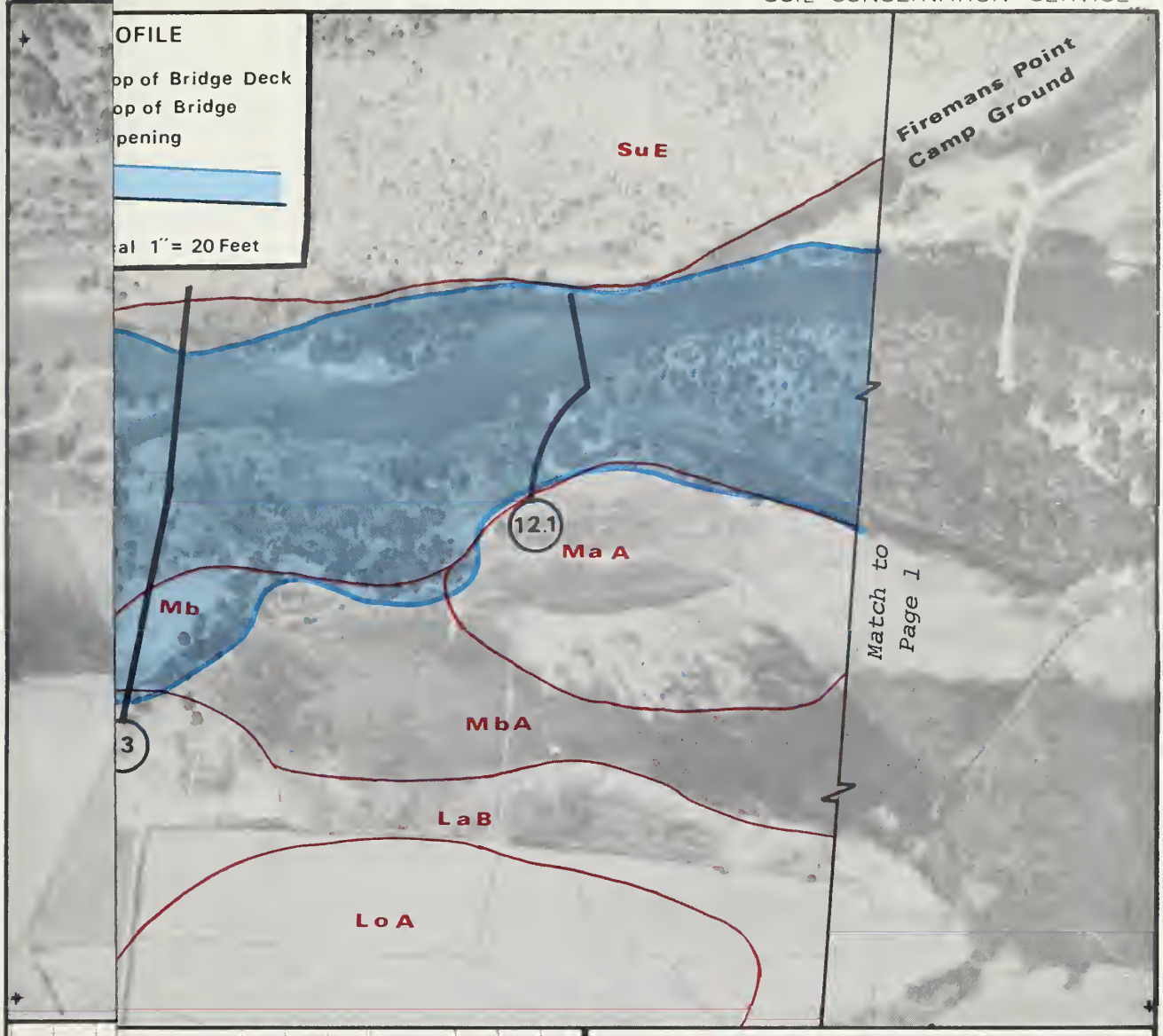
Flood Hazard Photomap and Water Surface Profiles

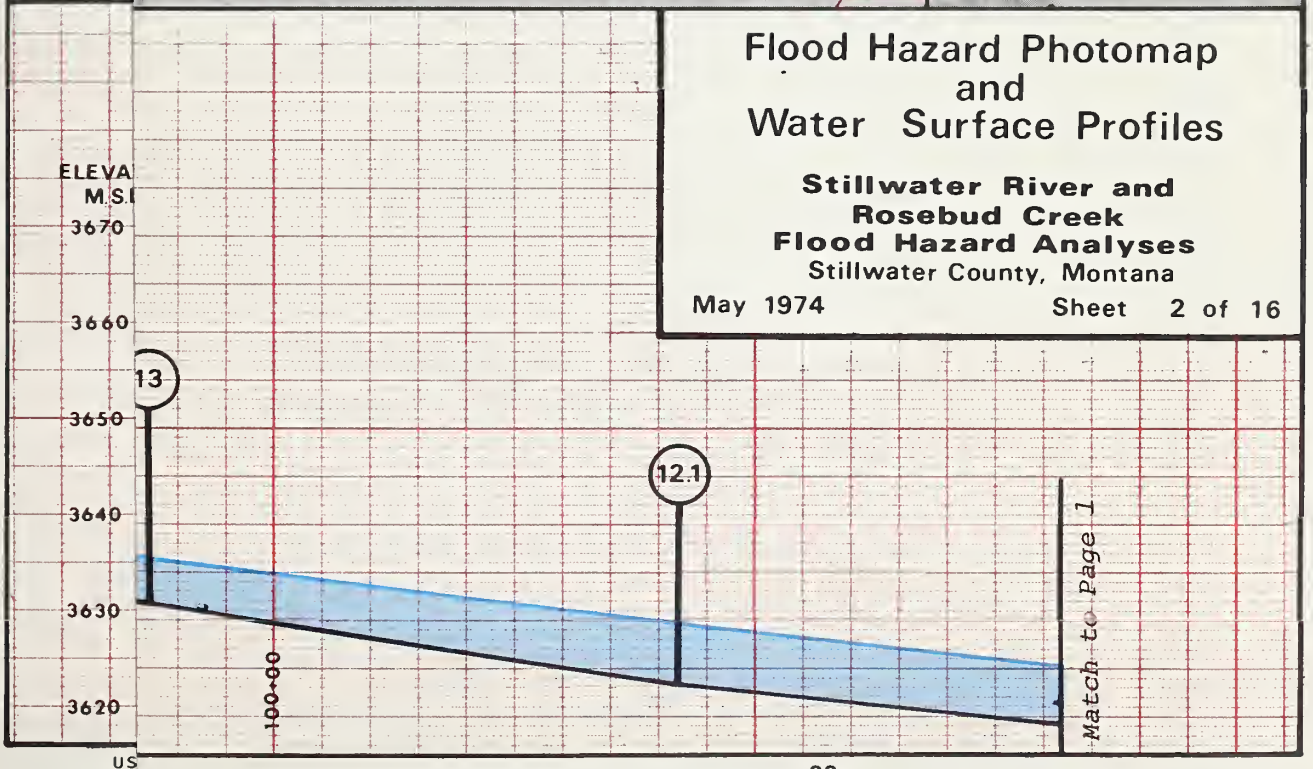
Stillwater River and Rosebud Creek Flood Hazard Analyses

Stillwater County, Montana

May 1974 Sheet 1 of 16

USDA—SCS—RB&WPP, BOZEMAN, MONTANA—1974



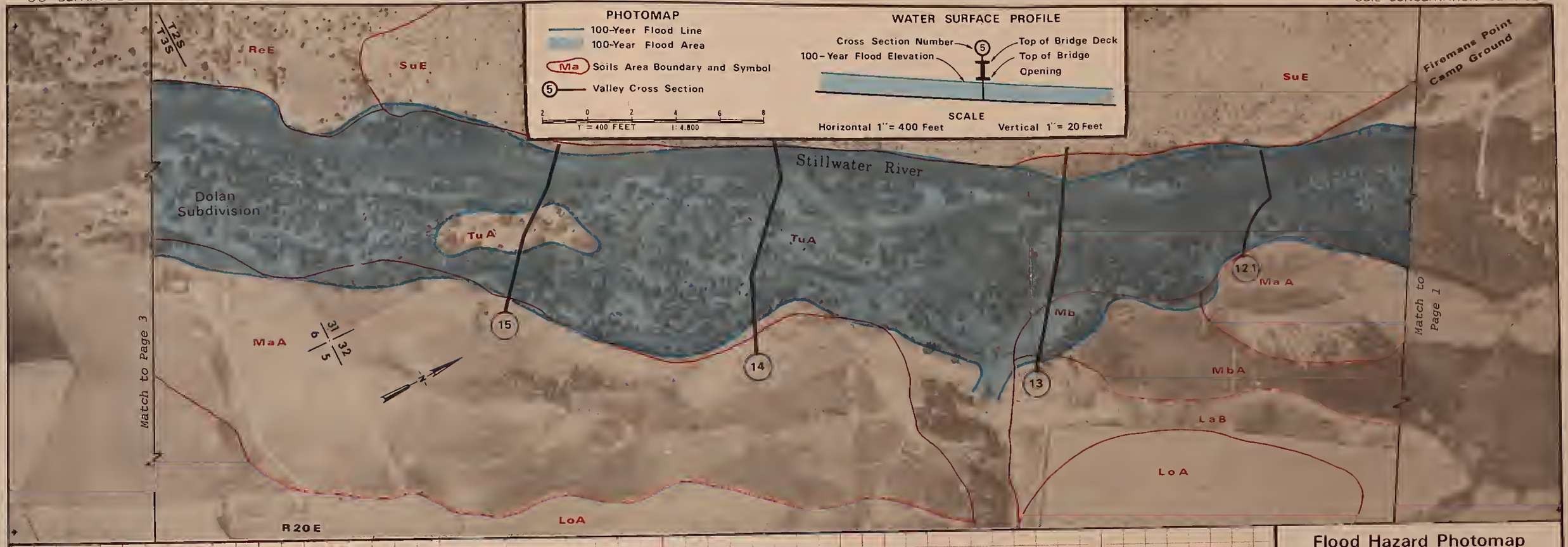


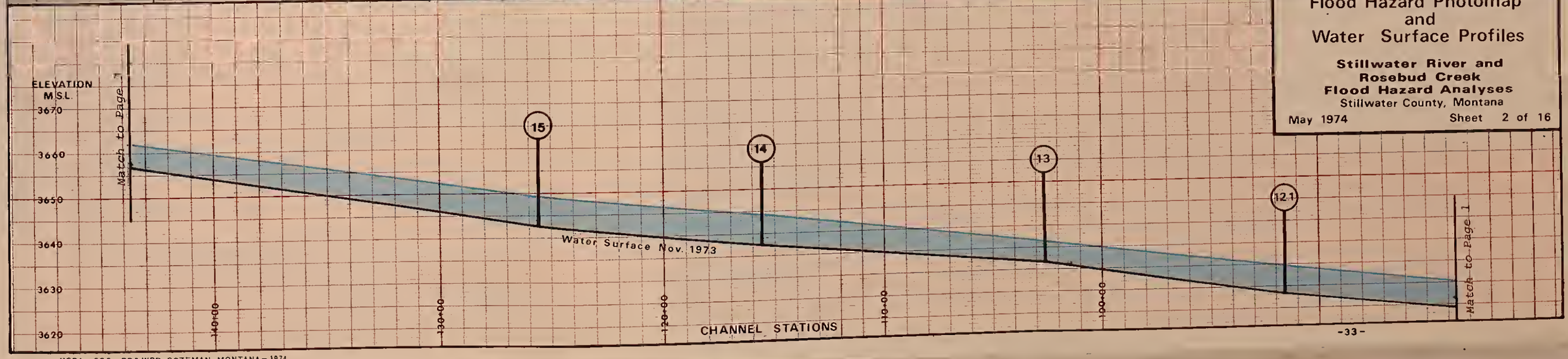
Flood Hazard Photomap and Water Surface Profiles

Stillwater River and Rosebud Creek Flood Hazard Analyses

Stillwater County, Montana

May 1974 Sheet 2 of 16





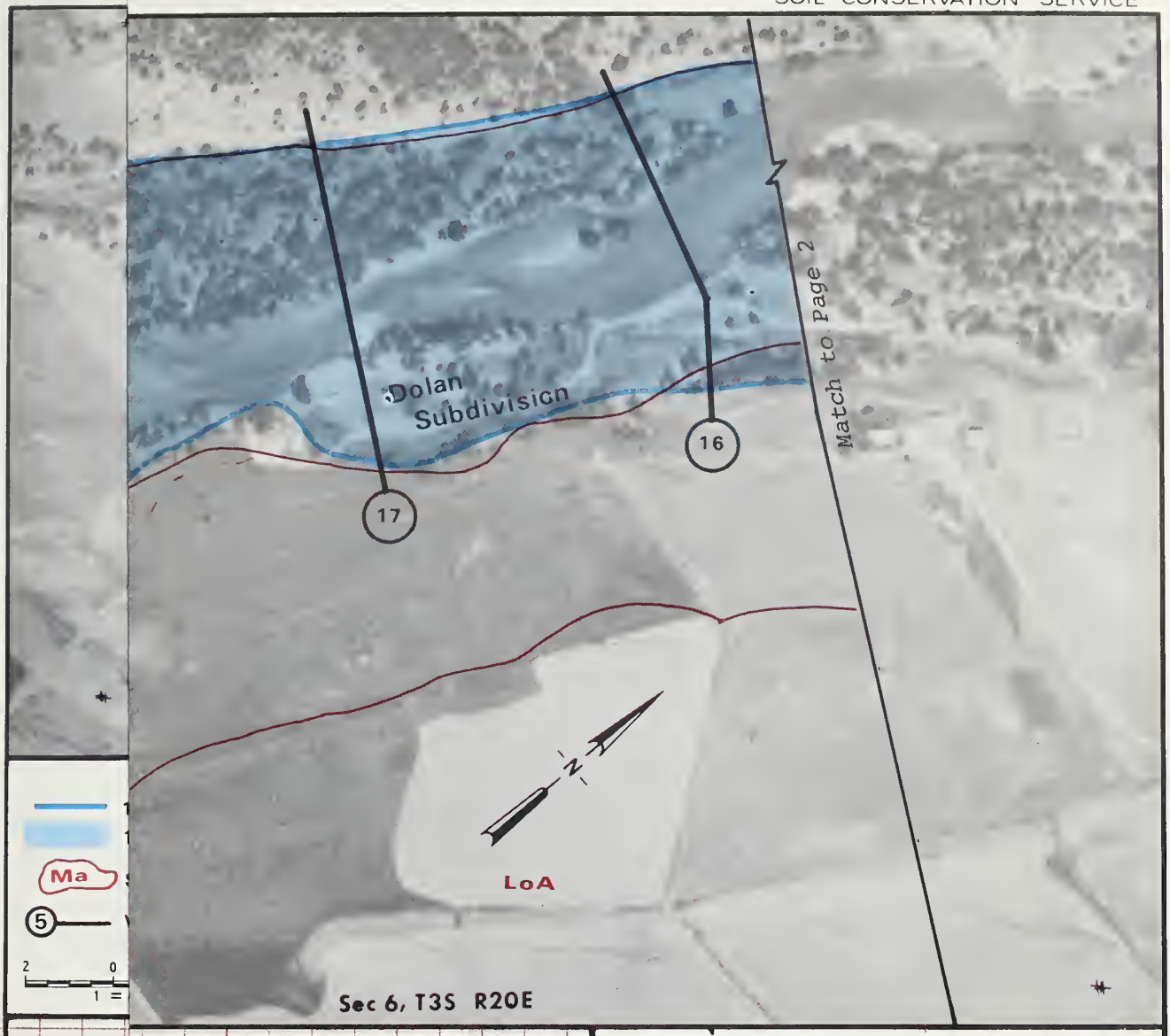
Flood Hazard Photomap and Water Surface Profiles

Stillwater River and Rosebud Creek Flood Hazard Analyses

Stillwater County, Montana

May 1974 Sheet 2 of 16

USDA- SCS--RB&WPP. BOZEMAN, MONTANA- 1974

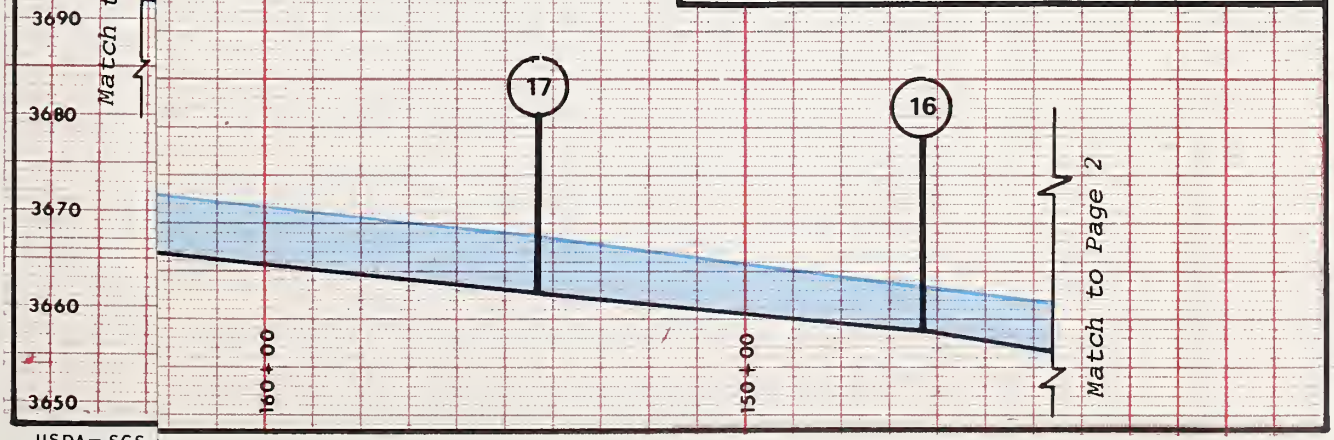


Flood Hazard Photomap and Water Surface Profiles

Stillwater River and Rosebud Creek Flood Hazard Analyses

Stillwater County, Montana

May 1974 Sheet 3 of 16



U.S. DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE

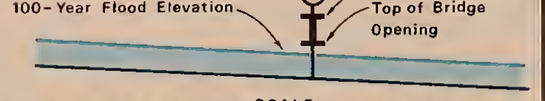
PHOTOMAP

- 100-Year Flood Line
- 100-Year Flood Area
- Ma — Soils Area Boundary and Symbol
- (5) — Valley Cross Section

2 0 2 4 6 8

1 = 400 FEET 1:4,800

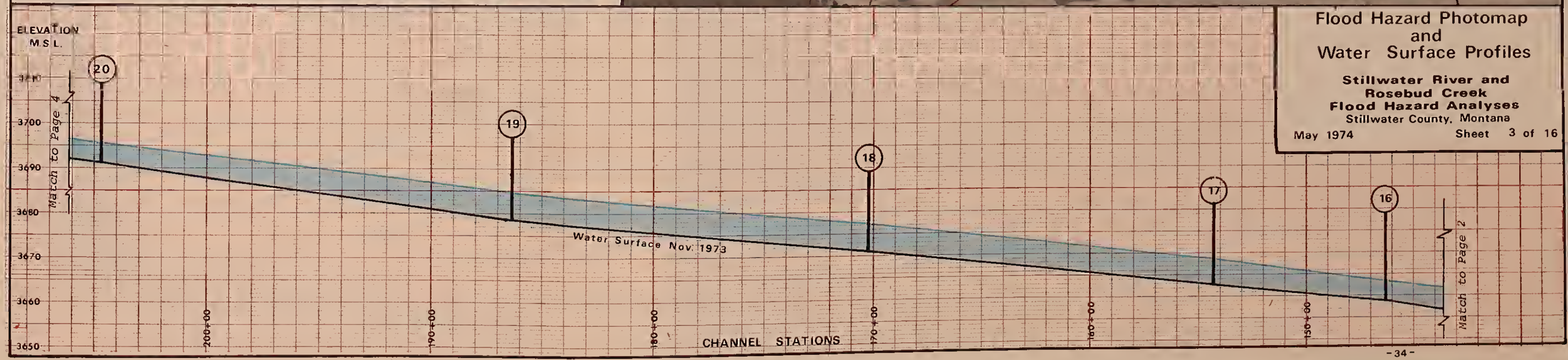
WATER SURFACE PROFILE



SCALE

Horizontal 1 = 400 Feet Vertical 1 = 20 Feet

Sec 6, T3S R20E



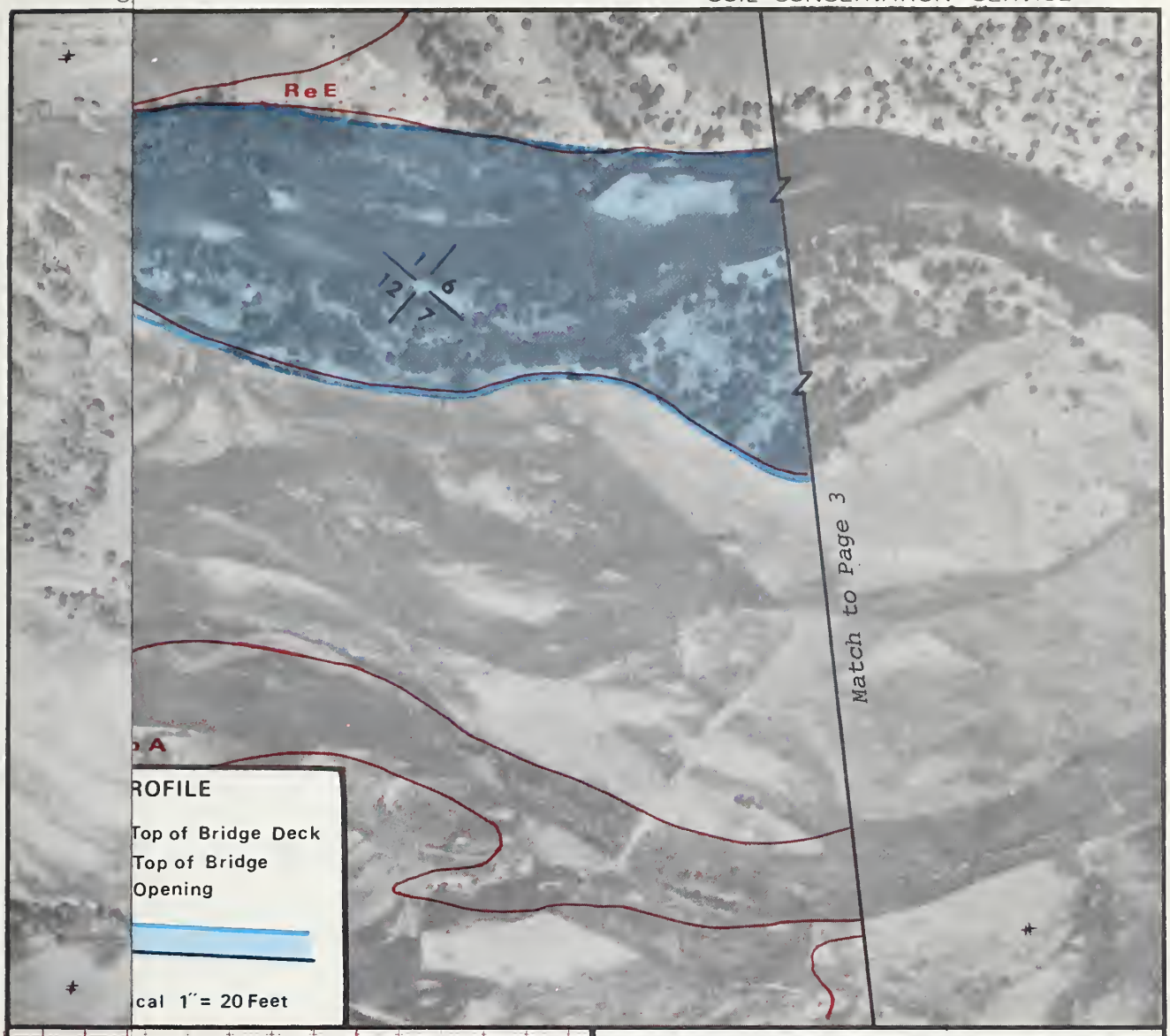
Flood Hazard Photomap and Water Surface Profiles

Stillwater River and Rosebud Creek Flood Hazard Analyses

Stillwater County, Montana

May 1974 Sheet 3 of 16

USDA—SCS—R&WPP, BOZEMAN, MONTANA—1974

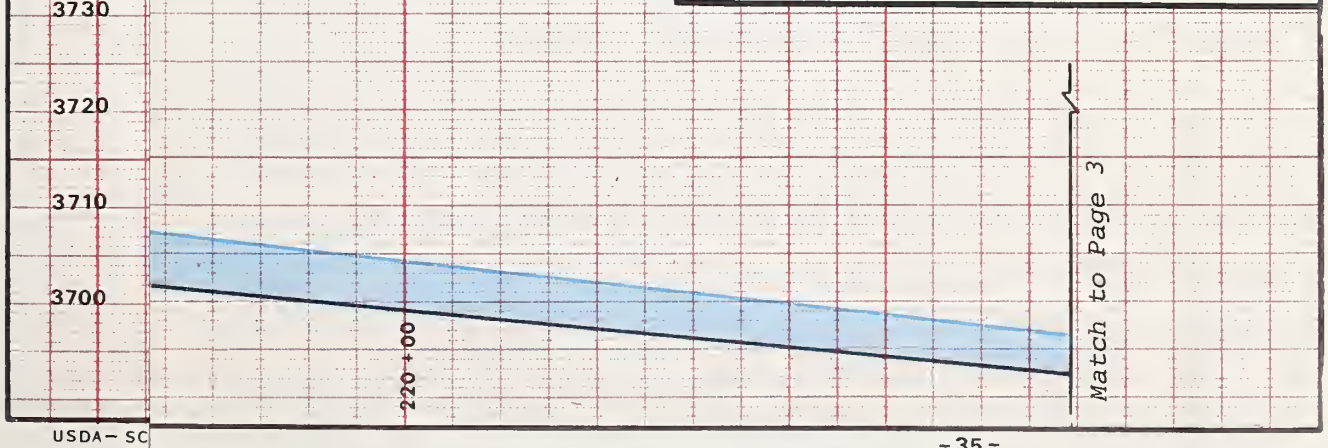


Flood Hazard Photomap and Water Surface Profiles

Stillwater River and Rosebud Creek Flood Hazard Analyses

Stillwater County, Montana

May 1974 Sheet 4 of 16



US DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE

PHOTOMAP

100-Year Flood Line

100-Year Flood Area

Ma Soils Area Boundary and Symbol

5 Valley Cross Section

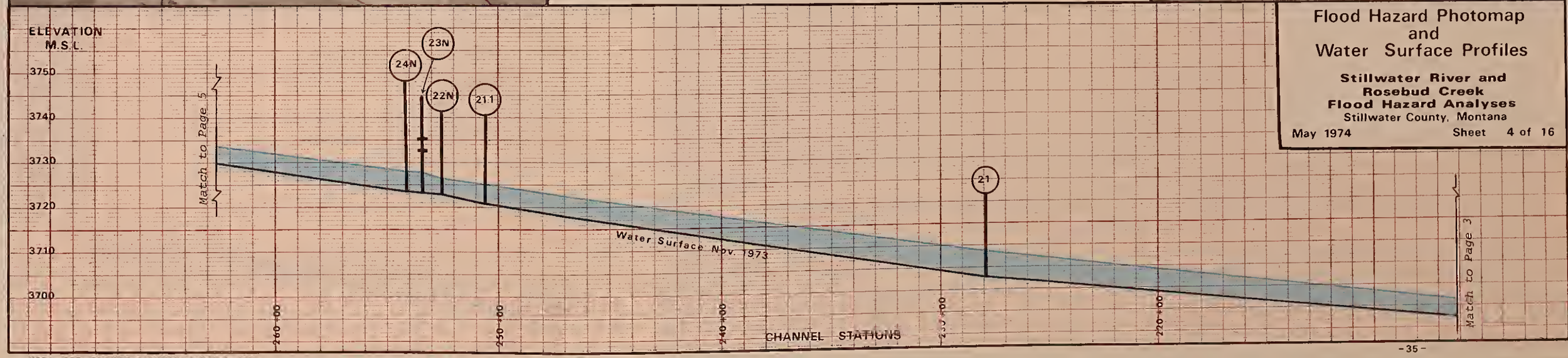
2 0 2 4 6 8

1 = 400 FEET 1: 4,800

WATER SURFACE PROFILE

SCALE

Horizontal 1" = 400 Feet Vertical 1" = 20 Feet



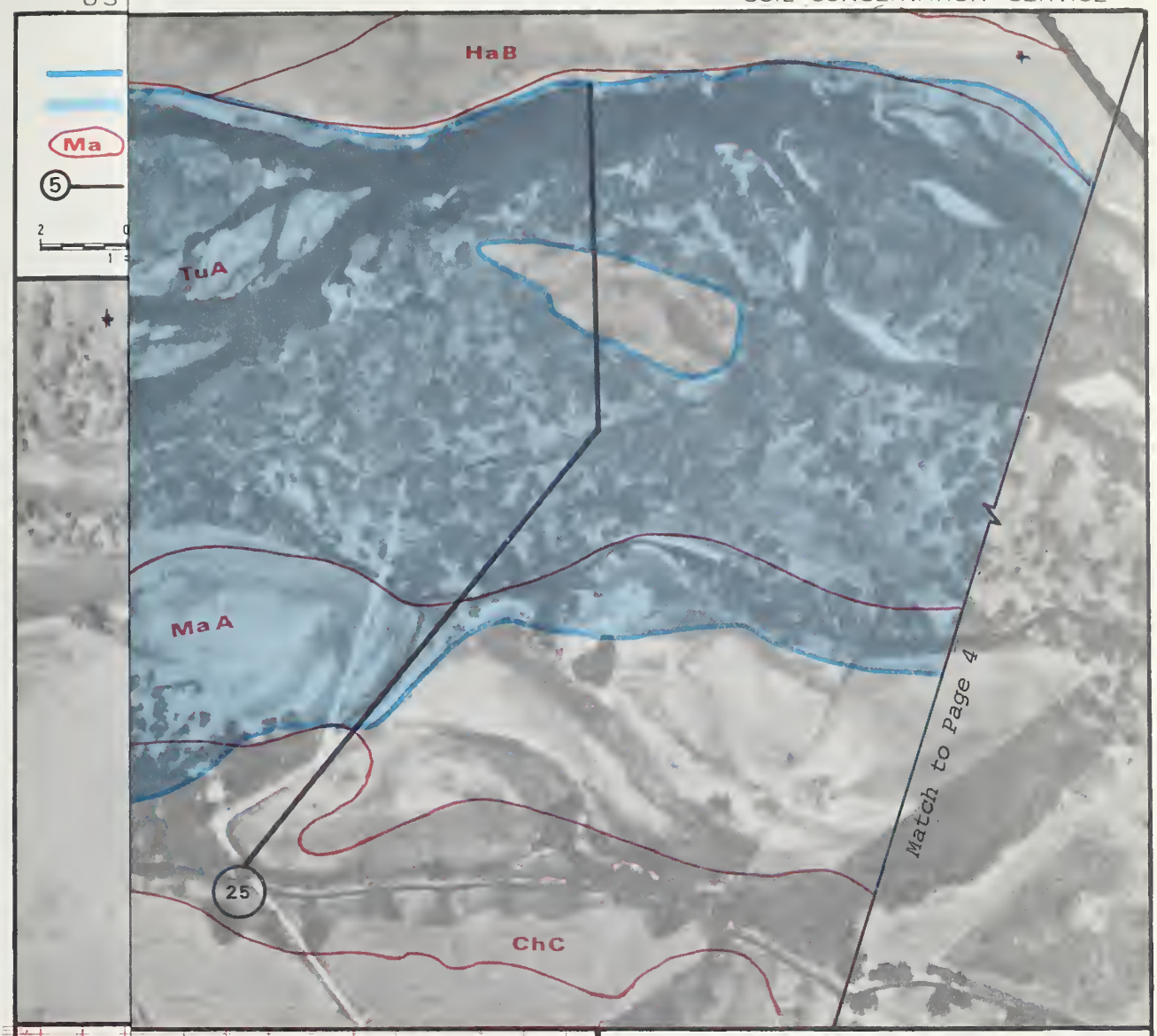
Flood Hazard Photomap and Water Surface Profiles

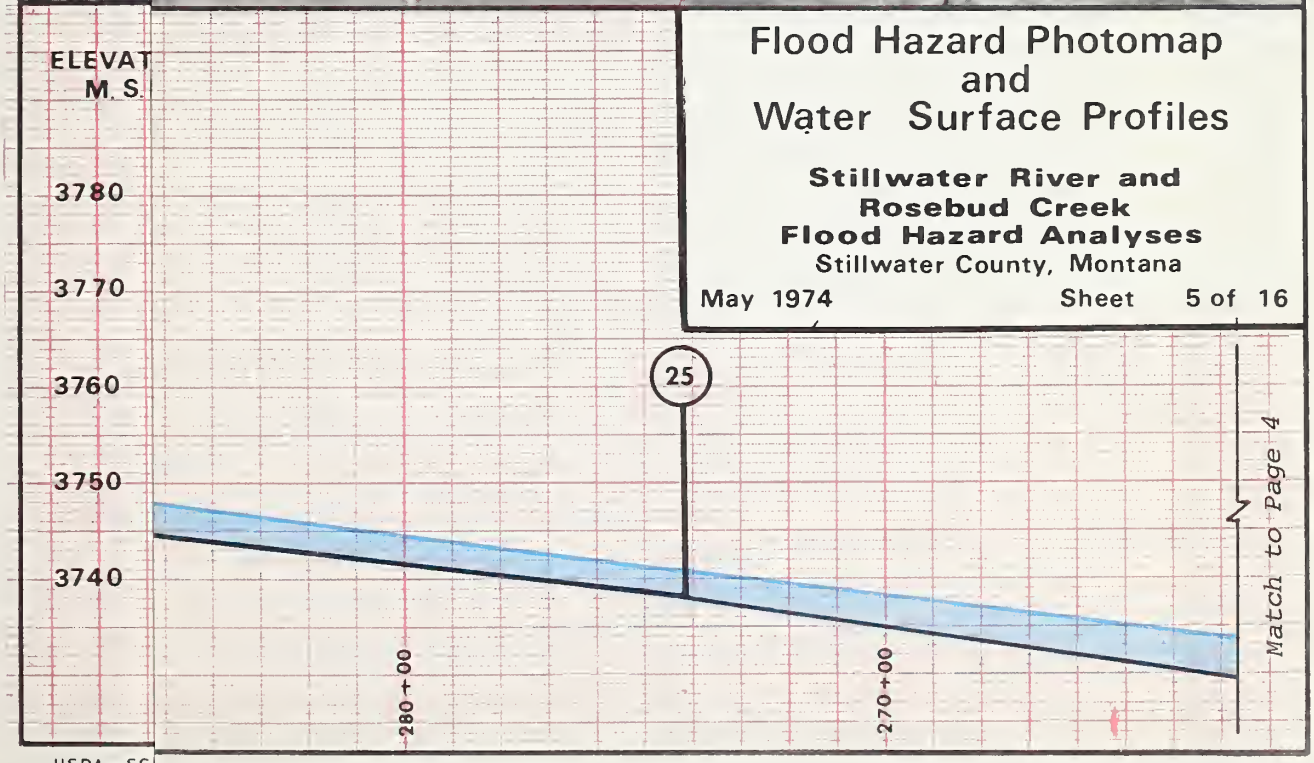
Stillwater River and Rosebud Creek Flood Hazard Analyses

Stillwater County, Montana

May 1974 Sheet 4 of 16

USDA - SCS - RB&WPP - BOZEMAN, MONTANA - 1974





Flood Hazard Photomap and Water Surface Profiles

Stillwater River and Rosebud Creek Flood Hazard Analyses

Stillwater County, Montana

May 1974 Sheet 5 of 16

U.S. DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE

PHOTOMAP

100-Year Flood Line

100-Year Flood Area

Ma Soils Area Boundary and Symbol

(5) Valley Cross Section

2 0 2 4 6 8

1 = 400 FEET 1:4,800

Woc

HaB

Hab

TuA

STILLWATER RIVER

HaA

MaA

LoA

ChC

11 12 14 13

N

T3S R19E

Match to Page 6

Match to Page 4

27.1 27 26 25

ELEVATION M.S.L.

3780

3770

3760

3750

3740

Water Surface Nov. 1973

CHANNEL STATIONS

310+00 300+00 290+00 280+00 270+00

WATER SURFACE PROFILE

Cross Section Number (5)

100-Year Flood Elevation

Top of Bridge Deck

Top of Bridge Opening

SCALE

Horizontal 1" = 400 Feet Vertical 1" = 20 Feet

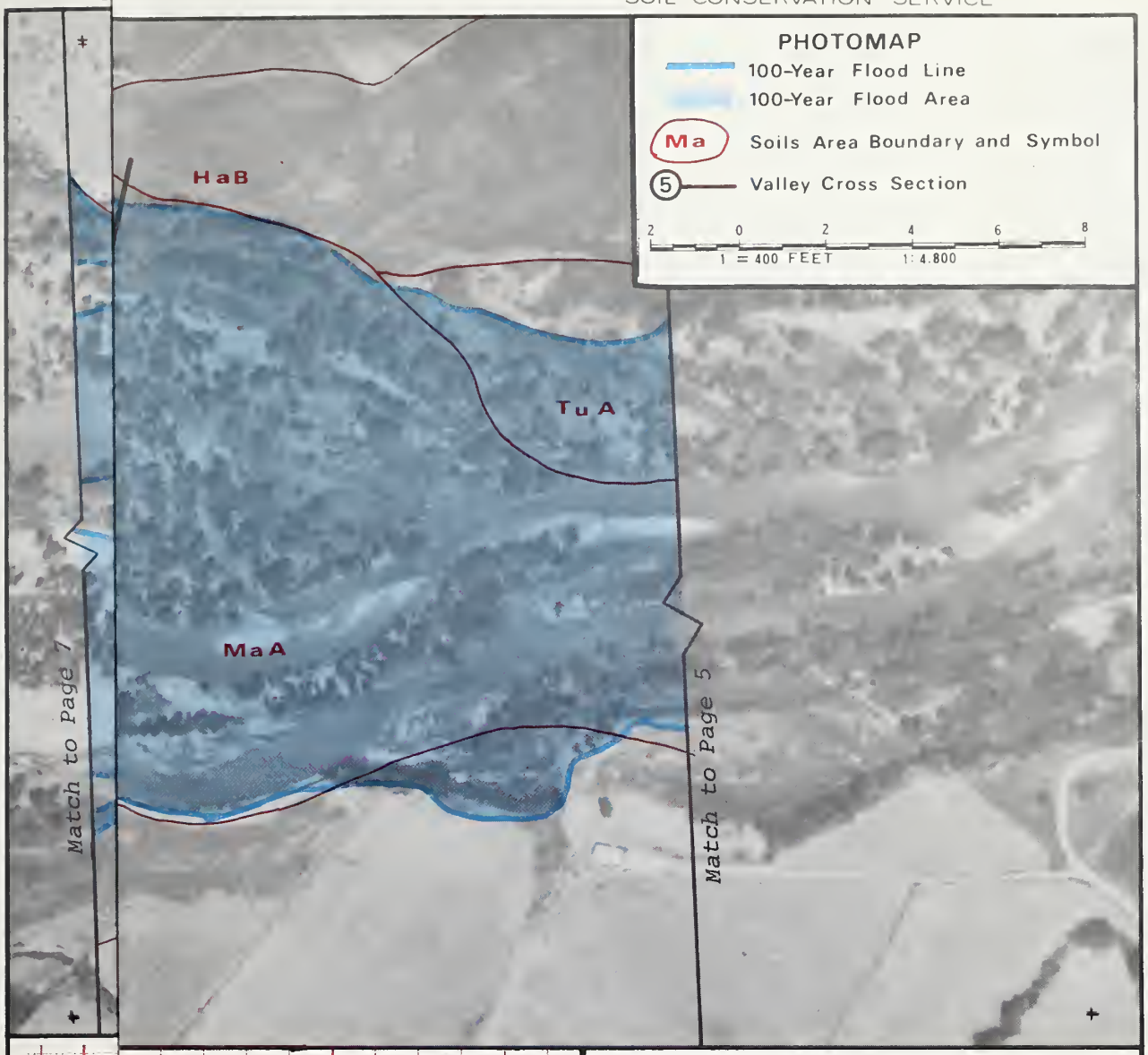
Flood Hazard Photomap and Water Surface Profiles

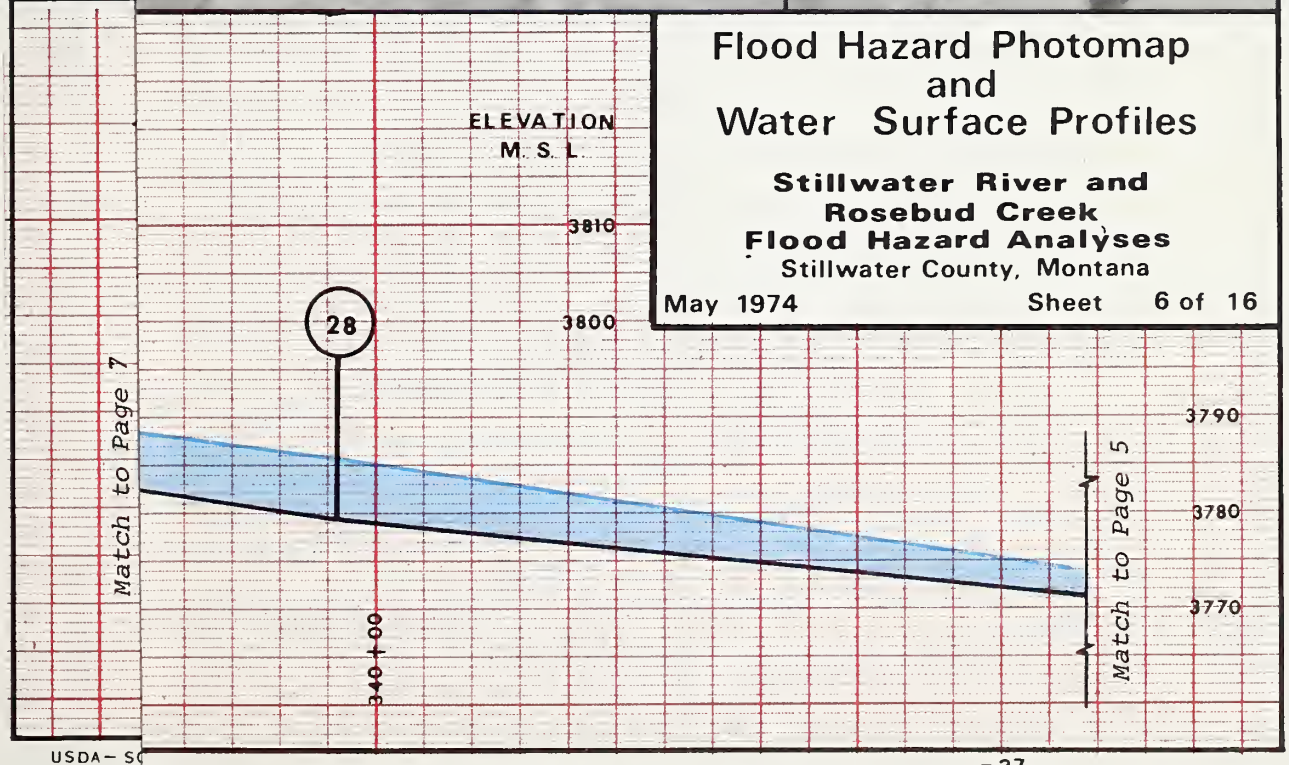
Stillwater River and Rosebud Creek Flood Hazard Analyses

Stillwater County, Montana

May 1974 Sheet 5 of 16

USDA-SCS-RB&WPP, BOZEMAN, MONTANA-1974





Flood Hazard Photomap and Water Surface Profiles

Stillwater River and Rosebud Creek Flood Hazard Analyses

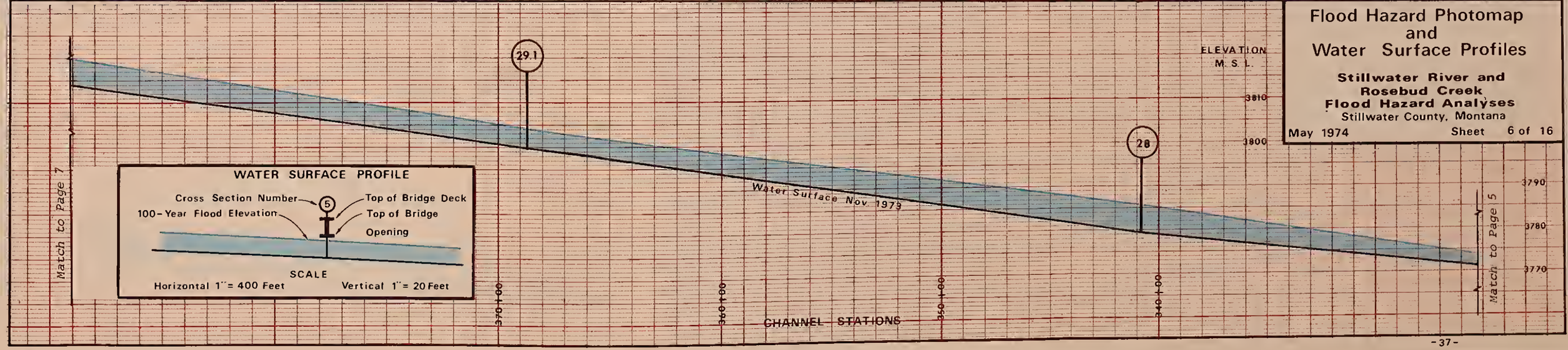
Stillwater County, Montana

May 1974 Sheet 6 of 16

USDA– SC

US DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE



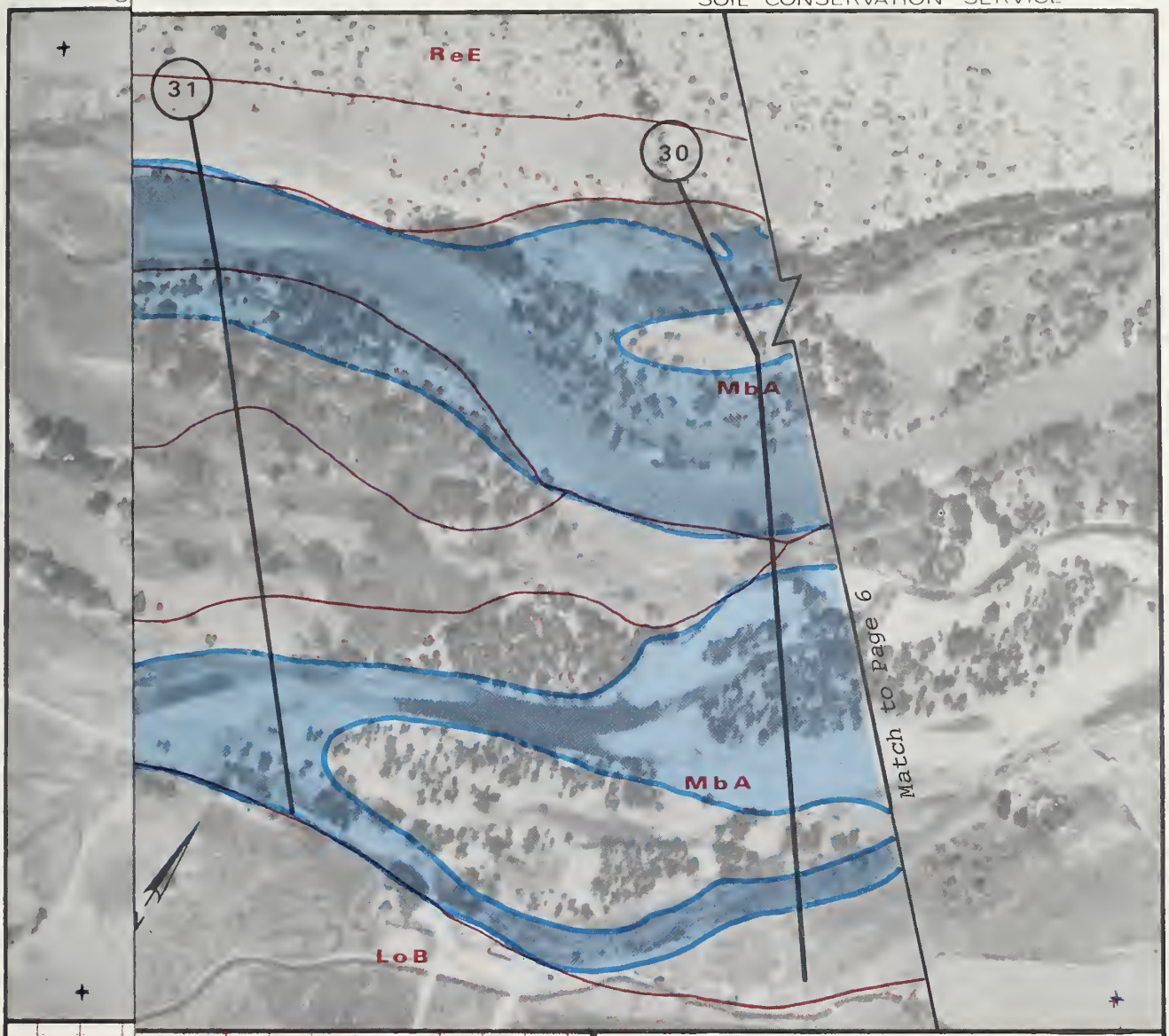
Flood Hazard Photomap and Water Surface Profiles

Stillwater River and Rosebud Creek Flood Hazard Analyses

Stillwater County, Montana

May 1974 Sheet 6 of 16

USDA– SCS– RB&WPP, BOZEMAN, MONTANA– 1974

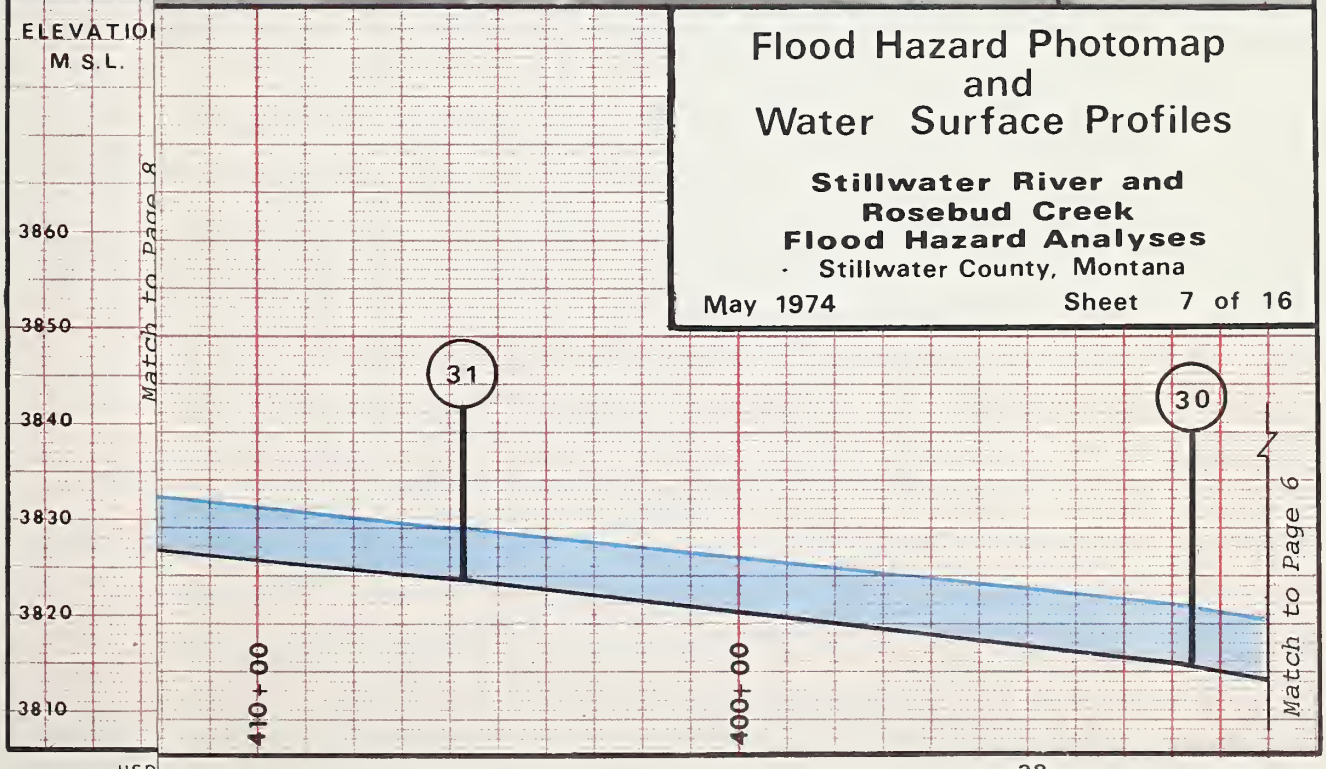


Flood Hazard Photomap and Water Surface Profiles

Stillwater River and Rosebud Creek Flood Hazard Analyses

Stillwater County, Montana

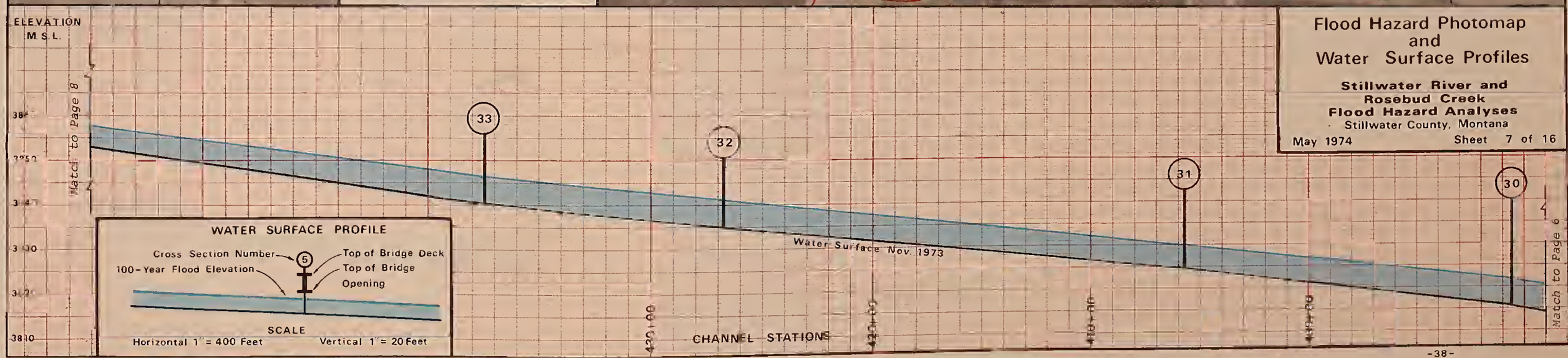
May 1974 Sheet 7 of 16



PHOTOMAP

- 100-Year Flood Line
- 100-Year Flood Area
- (Ma) Soils Area Boundary and Symbol
- (5) Valley Cross Section

2 0 2 4 6 8
1 = 400 FEET 1:4,800



WATER SURFACE PROFILE

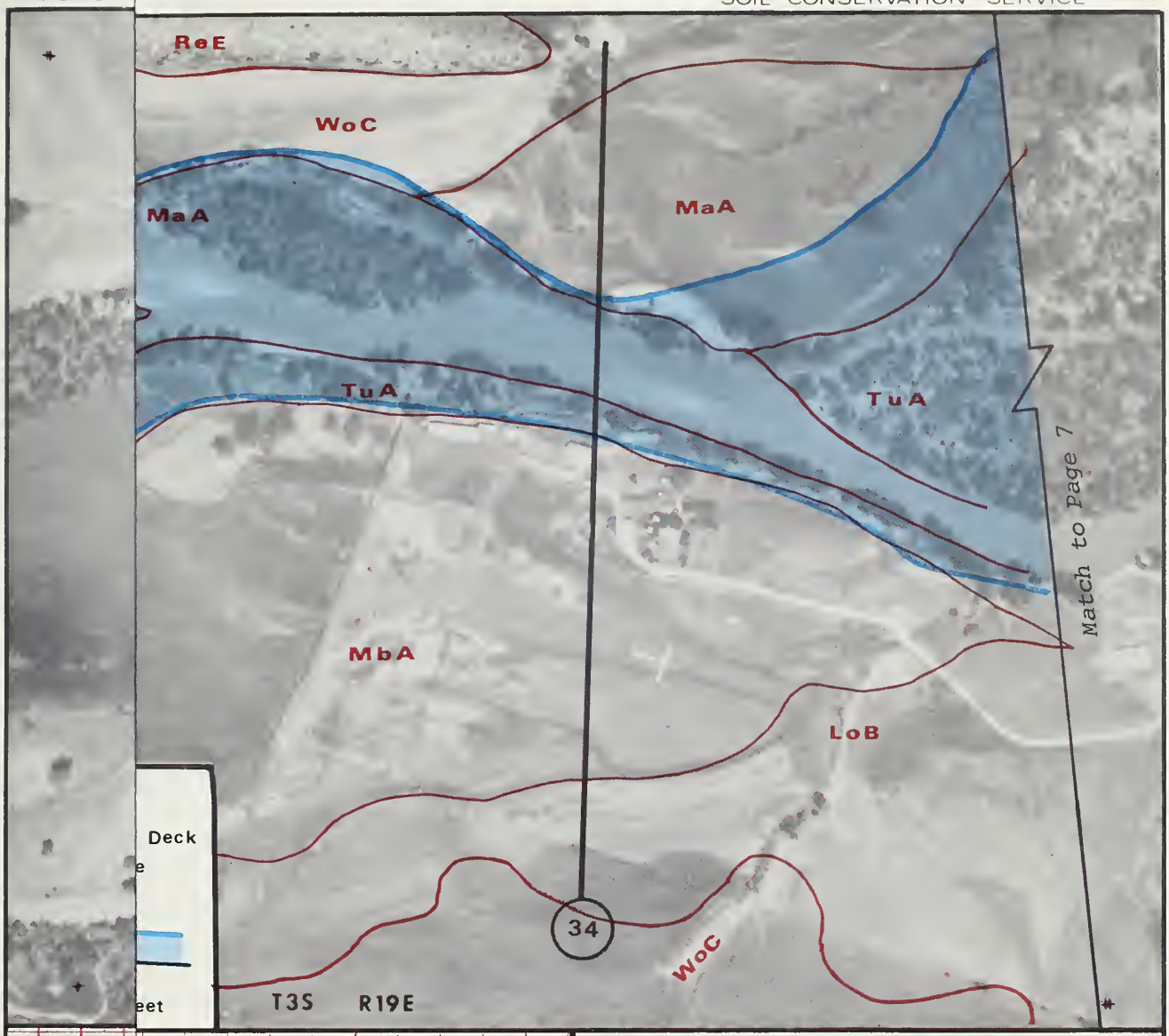
Cross Section Number (5) — Top of Bridge Deck
100-Year Flood Elevation — Top of Bridge Opening

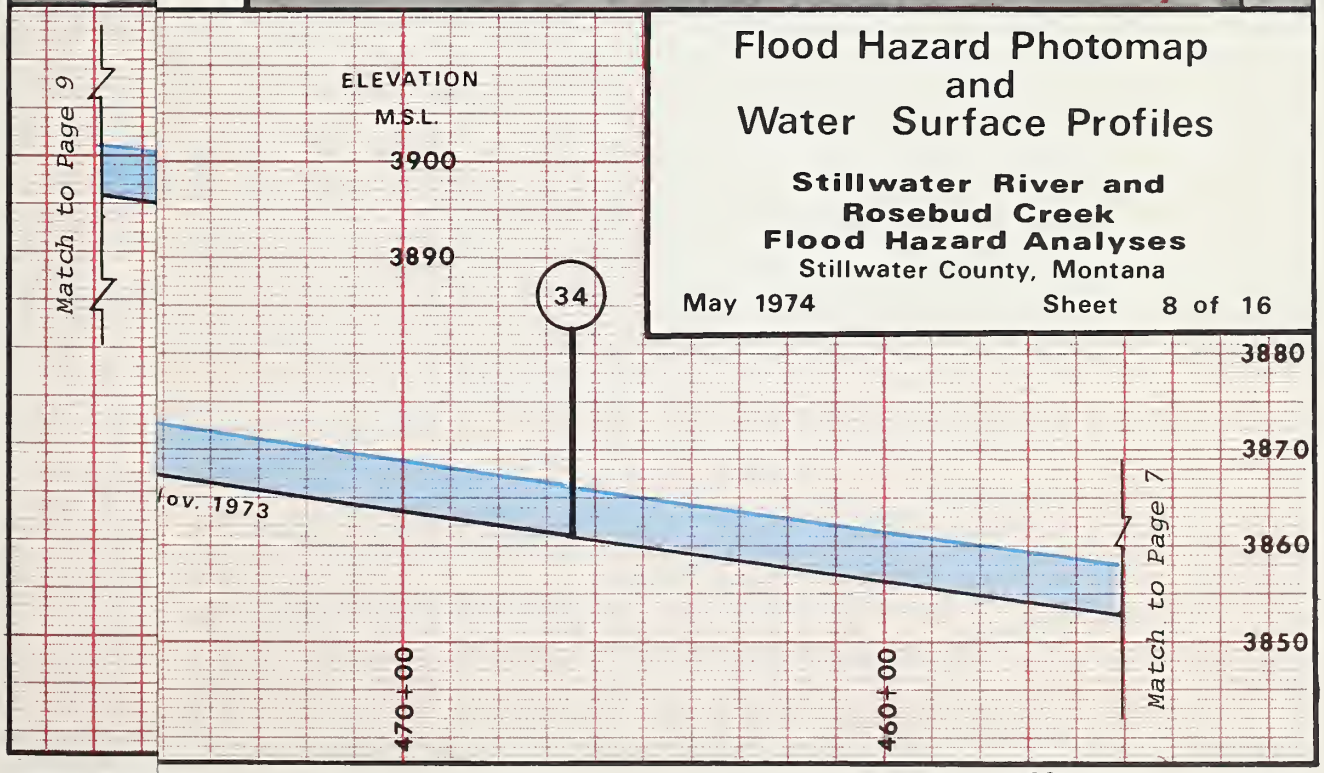
SCALE
Horizontal 1" = 400 Feet Vertical 1" = 20 Feet

Flood Hazard Photomap and Water Surface Profiles

Stillwater River and Rosebud Creek Flood Hazard Analyses
Stillwater County, Montana

May 1974 Sheet 7 of 16





Flood Hazard Photomap and Water Surface Profiles

Stillwater River and Rosebud Creek Flood Hazard Analyses

Stillwater County, Montana

May 1974 Sheet 8 of 16

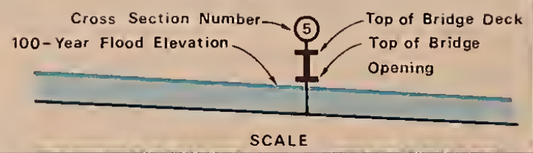
PHOTOMAP

- 100-Year Flood Line
- 100-Year Flood Area
- Ma — Soils Area Boundary and Symbol
- (5) — Valley Cross Section

2 0 2 4 6 8

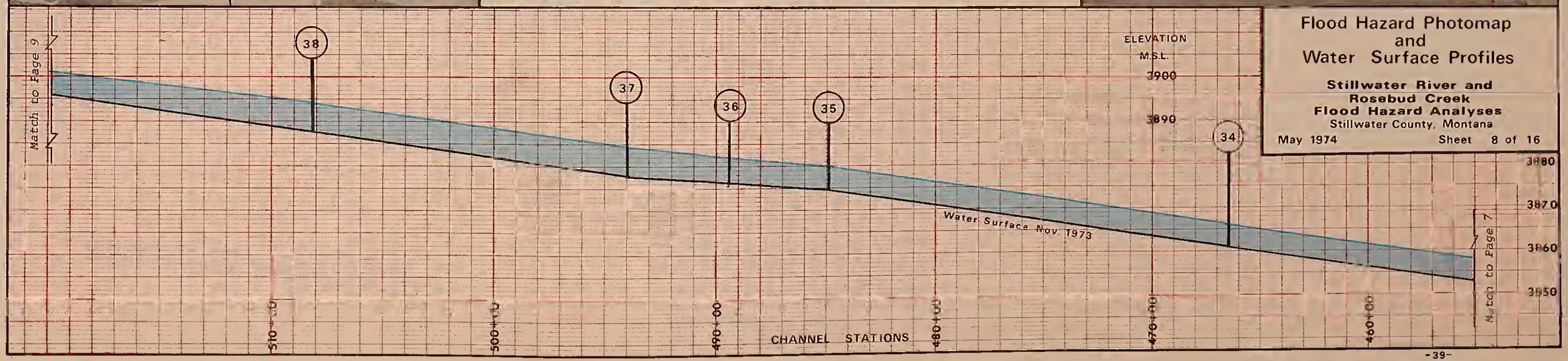
1 = 400 FEET 1:4,800

WATER SURFACE PROFILE



SCALE

Horizontal 1" = 400 Feet Vertical 1" = 20 Feet



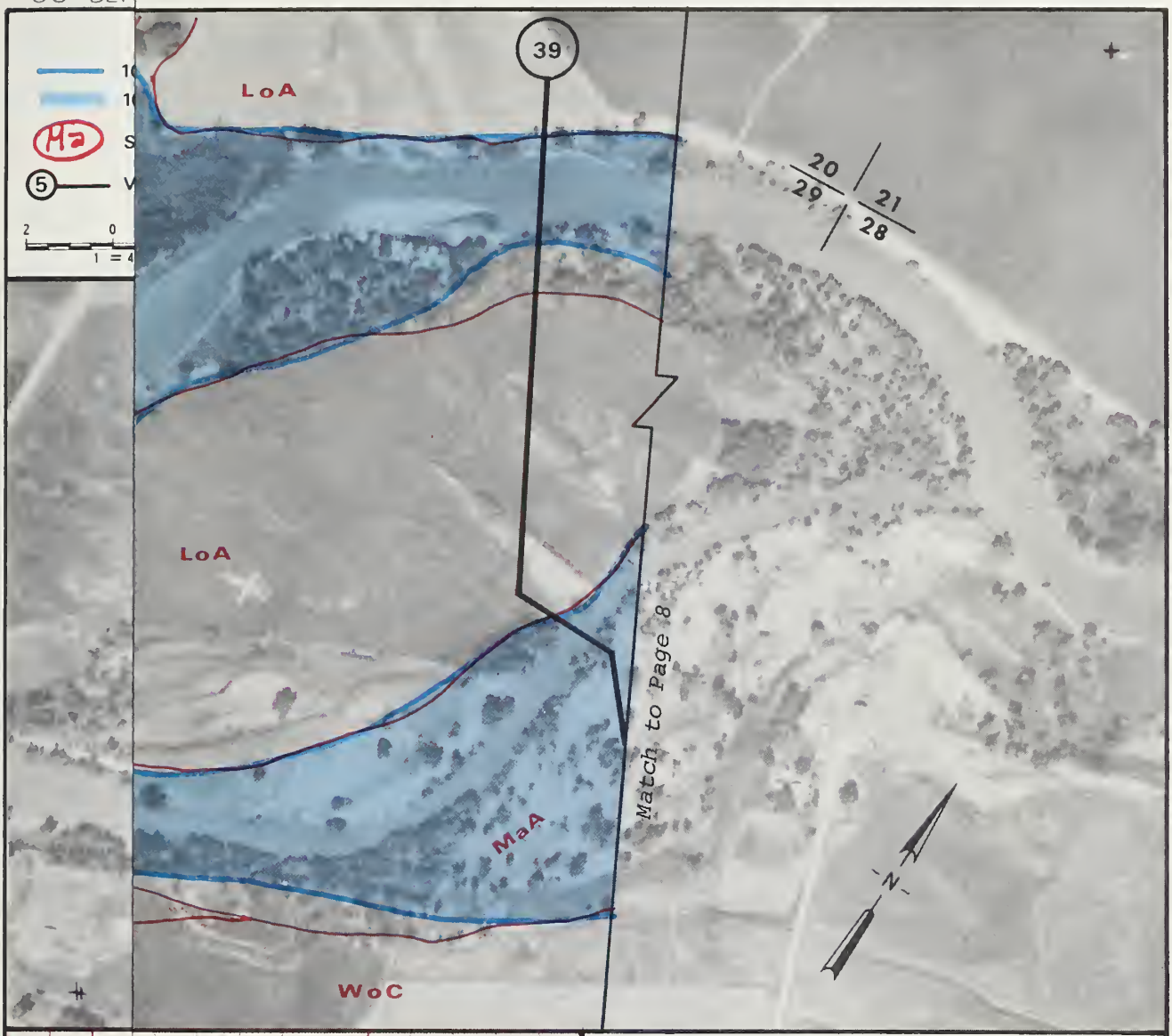
Flood Hazard Photomap and Water Surface Profiles

Stillwater River and Rosebud Creek Flood Hazard Analyses

Stillwater County, Montana

May 1974 Sheet 8 of 16

USDA– SCS– RB&WPP. BOZEMAN, MONTANA– 1974

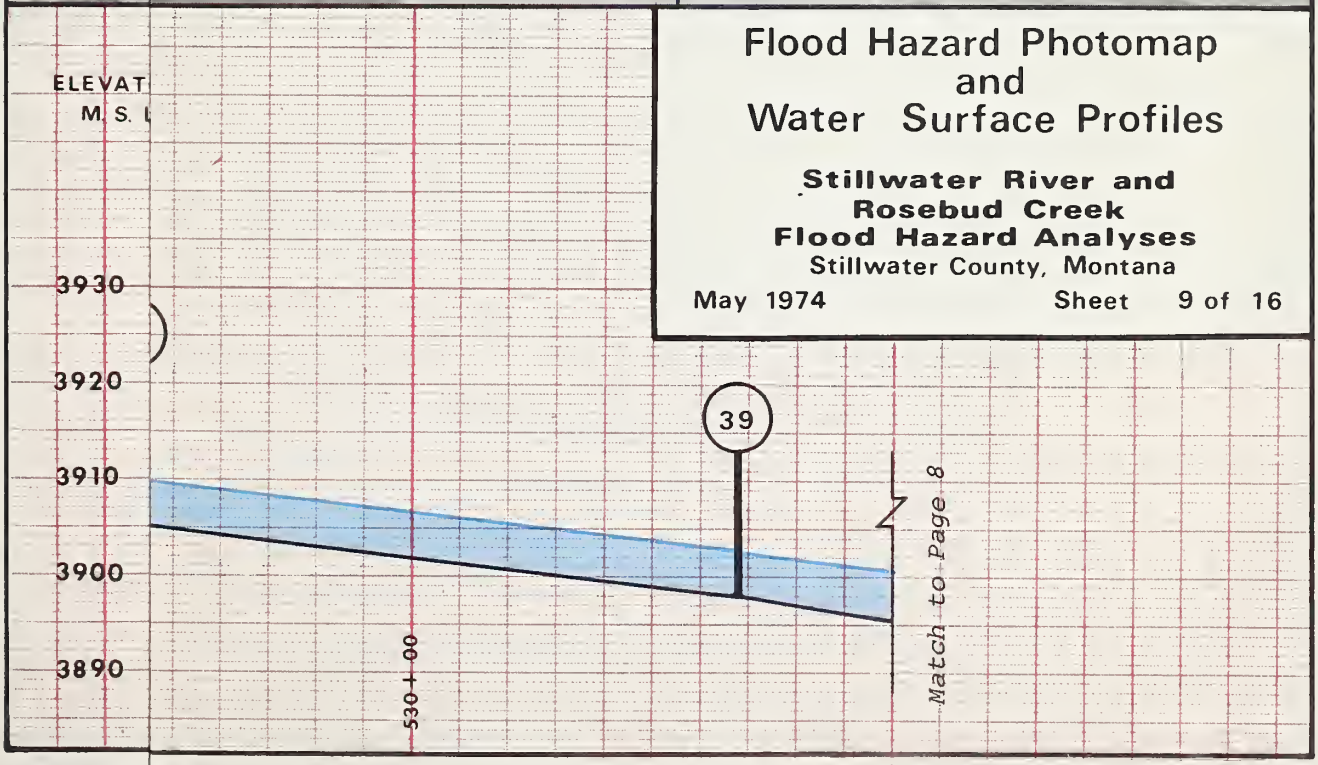


Flood Hazard Photomap and Water Surface Profiles

Stillwater River and Rosebud Creek Flood Hazard Analyses

Stillwater County, Montana

May 1974 Sheet 9 of 16



US DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE

PHOTOMAP
100-Year Flood Line
100-Year Flood Area
Ma Soils Area Boundary and Symbol
5 Valley Cross Section
2 0 2 4 6 8
1 = 400 FEET 1:4,800

ChB
MaA
LoA
WoC
T3S R19E
20 29 21 28
Match to Page 10
Match to Page 8

ELEVATION M. S. L.
3930
3920
3910
3900
Match to Page 10
Match to Page 8
Water Surface Nov. 1973
CHANNEL STATIONS
560+00
550+00
540+00
530+00

WATER SURFACE PROFILE
Cross Section Number 5
100-Year Flood Elevation
Top of Bridge Deck
Top of Bridge Opening
SCALE
Horizontal 1" = 400 Feet Vertical 1" = 20 Feet

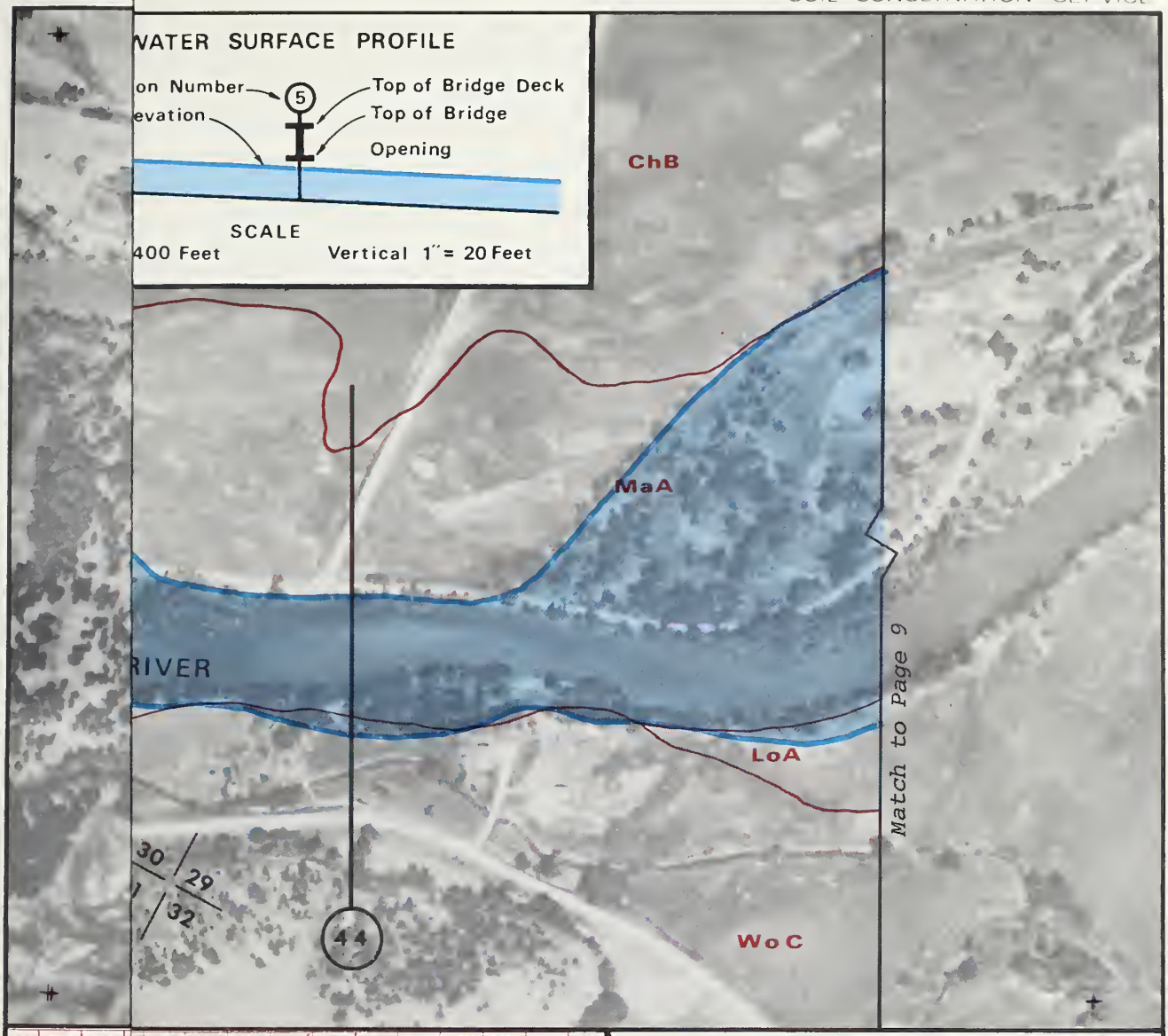
Flood Hazard Photomap and Water Surface Profiles

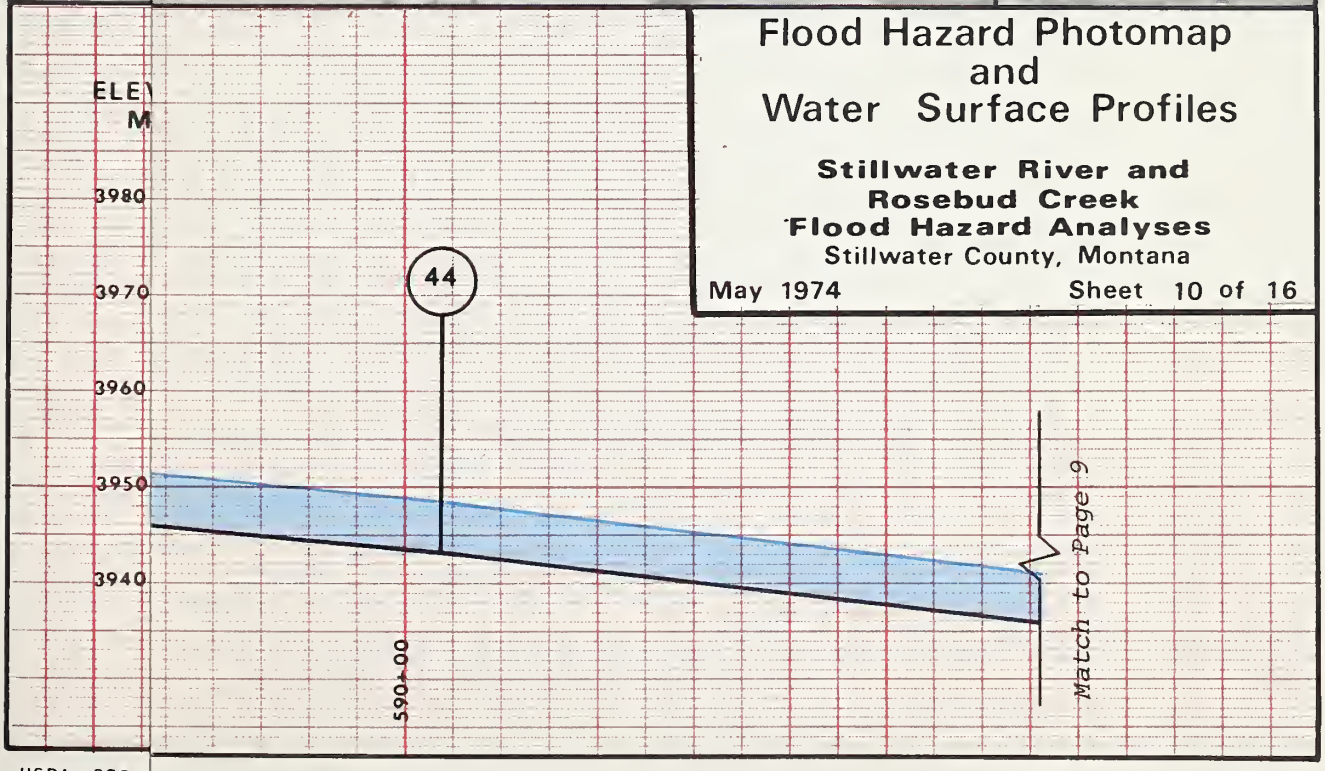
Stillwater River and Rosebud Creek Flood Hazard Analyses

Stillwater County, Montana

May 1974 Sheet 9 of 16

USDA-SCS-RBA WPP BOZEMAN, MONTANA-1974





Flood Hazard Photomap and Water Surface Profiles

Stillwater River and Rosebud Creek Flood Hazard Analyses

Stillwater County, Montana

May 1974 Sheet 10 of 16

PHOTOMAP
100-Year Flood Line
100-Year Flood Area
Ma Soils Area Boundary and Symbol
5 Valley Cross Section

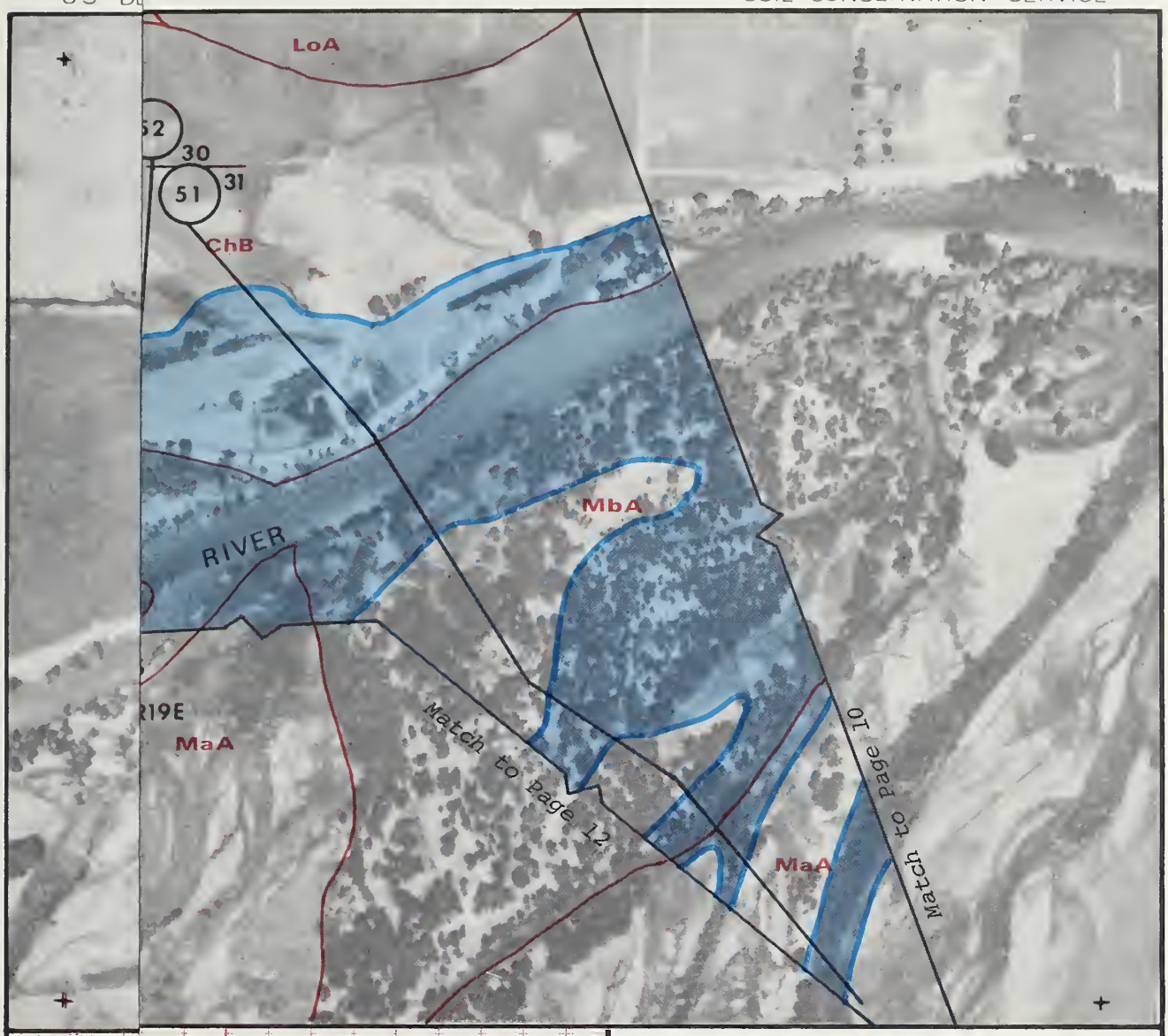
WATER SURFACE PROFILE
Cross Section Number
100-Year Flood Elevation
Top of Bridge Deck
Top of Bridge
Opening
SCALE
Horizontal 1" = 400 Feet
Vertical 1" = 20 Feet

ChB
MbA
MaA
WoC
LoA
STILLWATER RIVER
50
49
48
47
46
45
44
30
29
31
32
Match to Page 11
Match to Page 9
N
135 RIVE

ELEVATION M.S.L.
Match to age 11
Water Surface Nov 1973
CHANNEL STATIONS
600+00
610+00
620+00
590+00
Match to Page 9

Flood Hazard Photomap and Water Surface Profiles

Stillwater River and Rosebud Creek Flood Hazard Analyses
Stillwater County, Montana
May 1974
Sheet 10 of 16

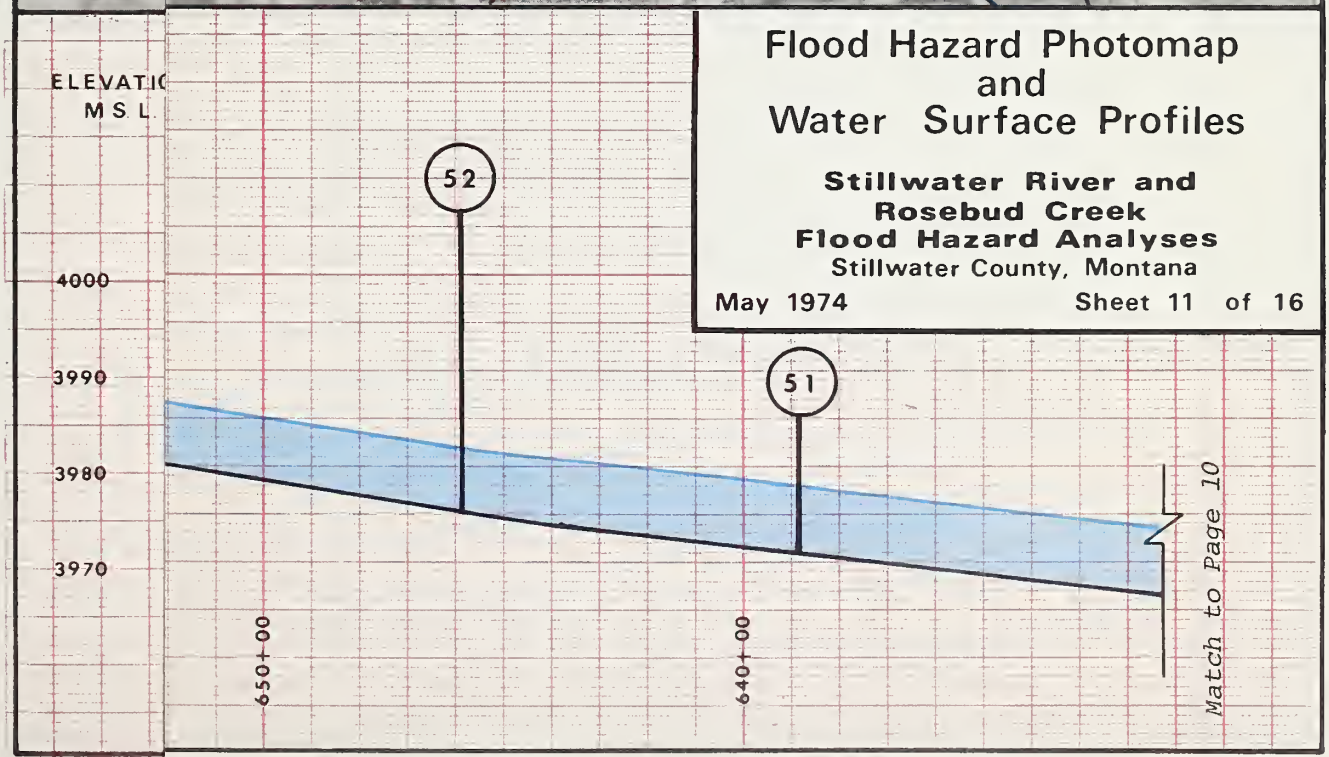


Flood Hazard Photomap and Water Surface Profiles

Stillwater River and Rosebud Creek Flood Hazard Analyses

Stillwater County, Montana

May 1974 Sheet 11 of 16



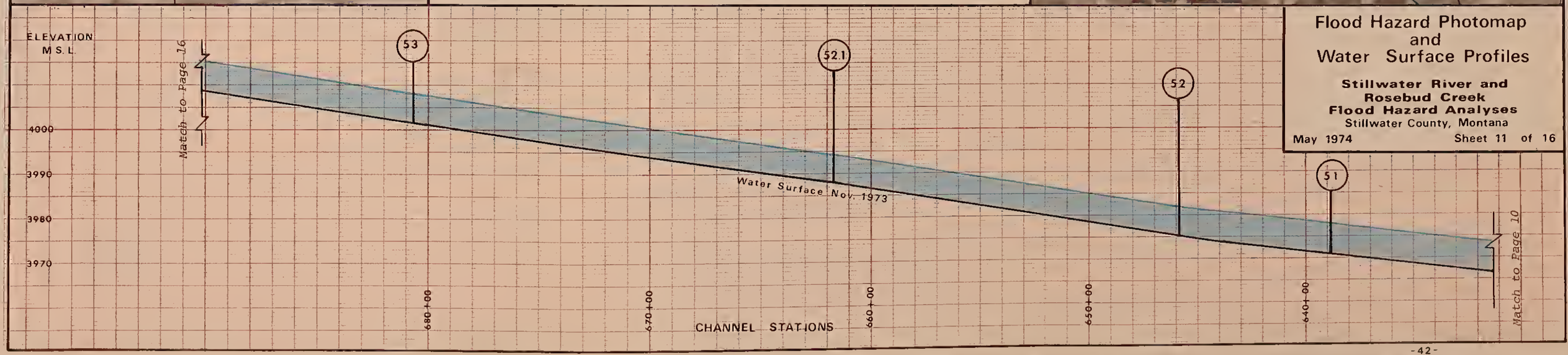
PHOTOMAP

100-Year Flood Line
100-Year Flood Area
Ma Soils Area Boundary and Symbol
5 Valley Cross Section

2 0 2 4 6 8
1 = 400 FEET 1: 4,800

WATER SURFACE PROFILE

SCALE
Horizontal 1" = 400 Feet Vertical 1" = 20 Feet

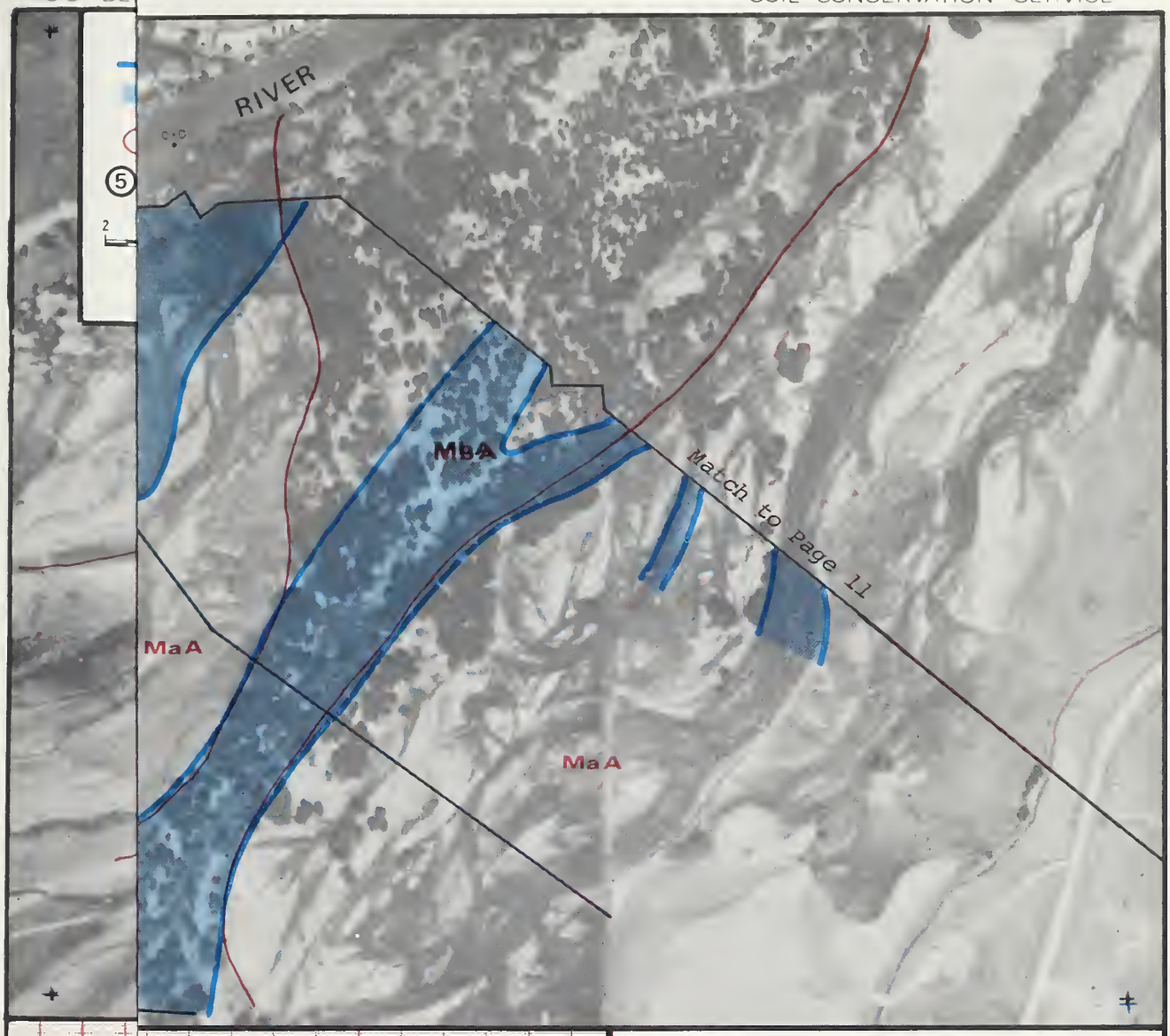


Flood Hazard Photomap and Water Surface Profiles

Stillwater River and Rosebud Creek Flood Hazard Analyses

Stillwater County, Montana

May 1974 Sheet 11 of 16



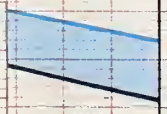
Flood Hazard Photomap and Water Surface Profiles

Stillwater River and Rosebud Creek Flood Hazard Analyses

Stillwater County, Montana

May 1974 Sheet 12 of 16

Match to Page 11

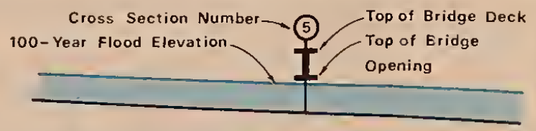


PHOTOMAP

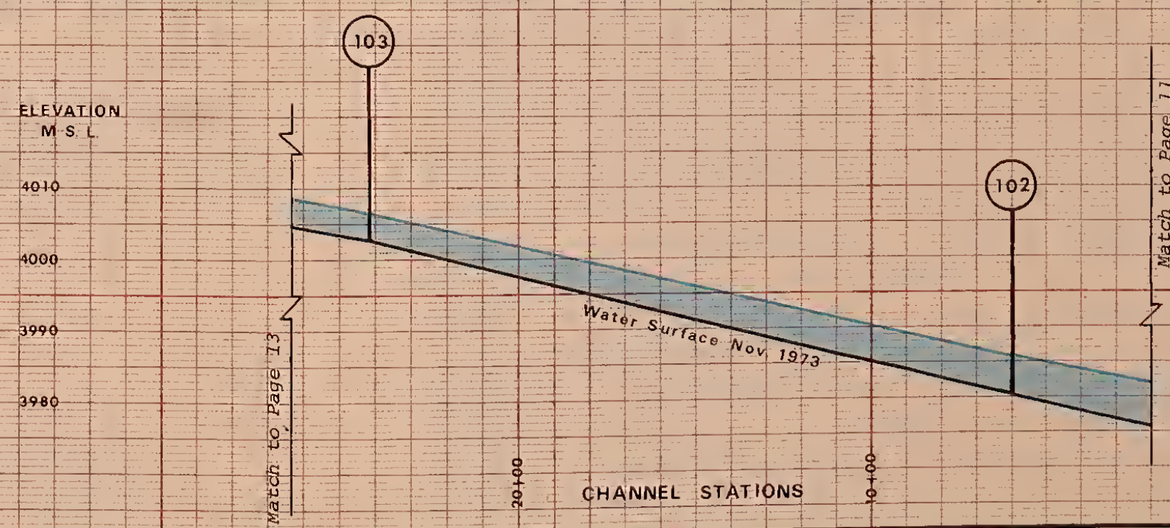
- 100-Year Flood Line
- 100-Year Flood Area
- Ma — Soils Area Boundary and Symbol
- (5) — Valley Cross Section

2 0 2 4 6 8
1" = 400 FEET 1: 4,800

WATER SURFACE PROFILE



SCALE
Horizontal 1"= 400 Feet Vertical 1"= 20 Feet

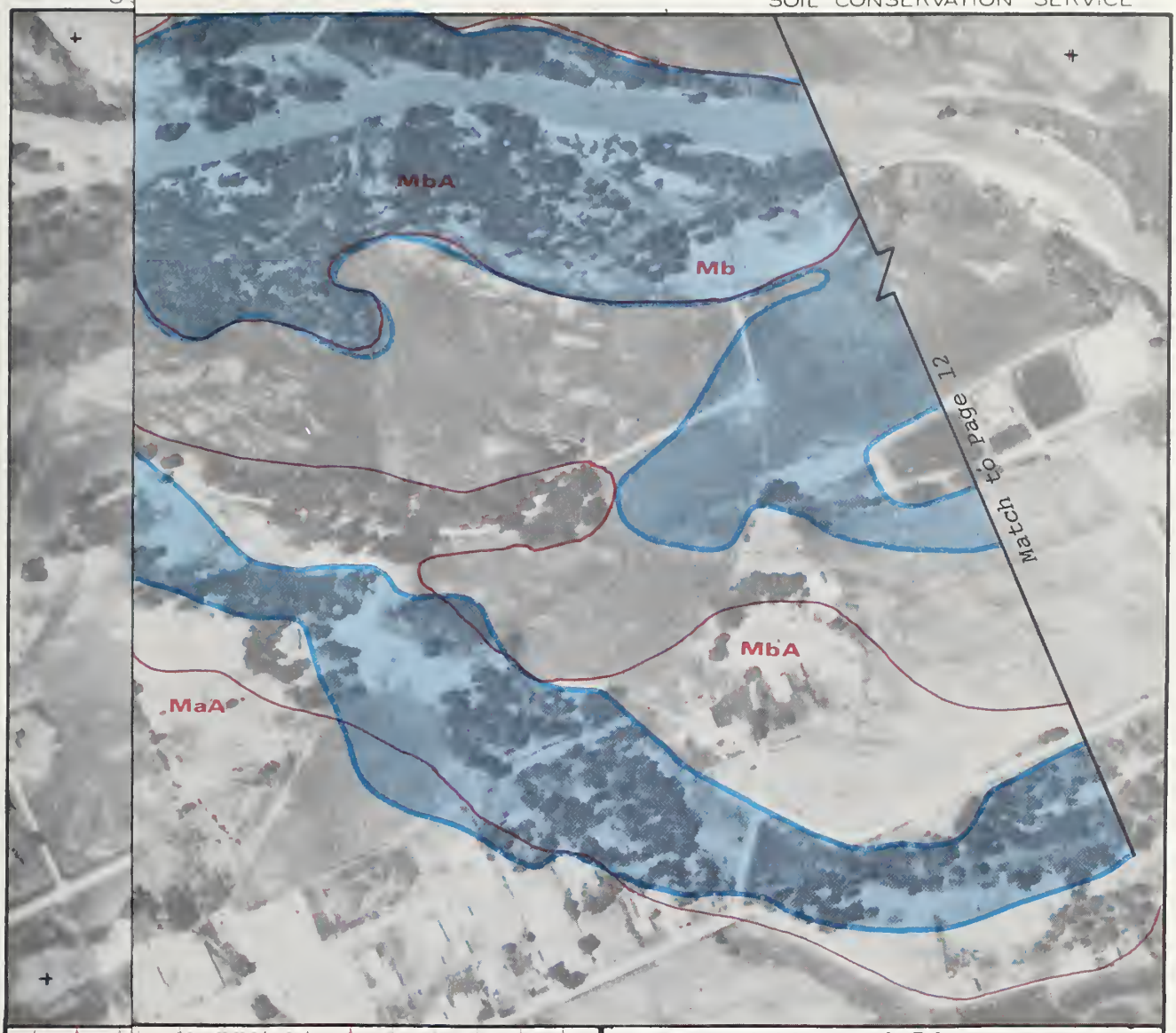


Flood Hazard Photomap and Water Surface Profiles

Stillwater River and Rosebud Creek Flood Hazard Analyses

Stillwater County, Montana

May 1974 Sheet 12 of 16

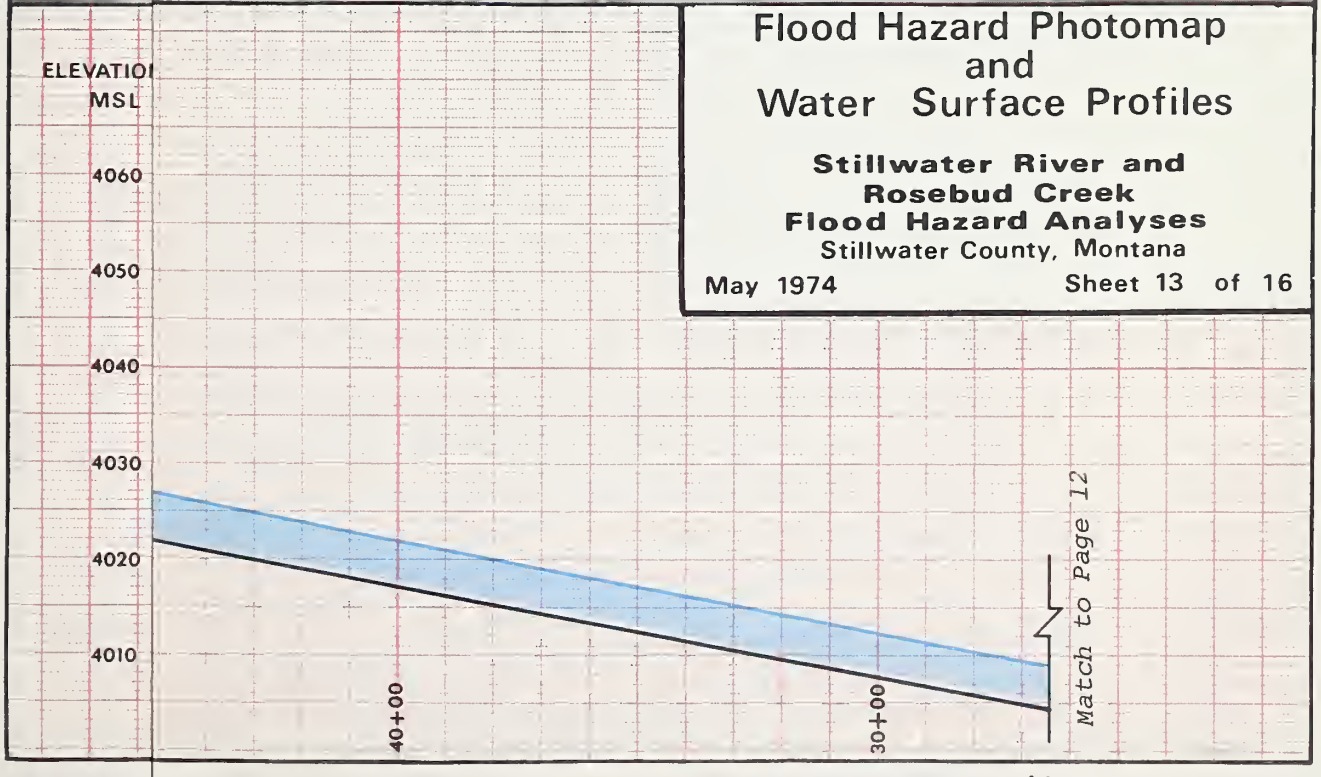


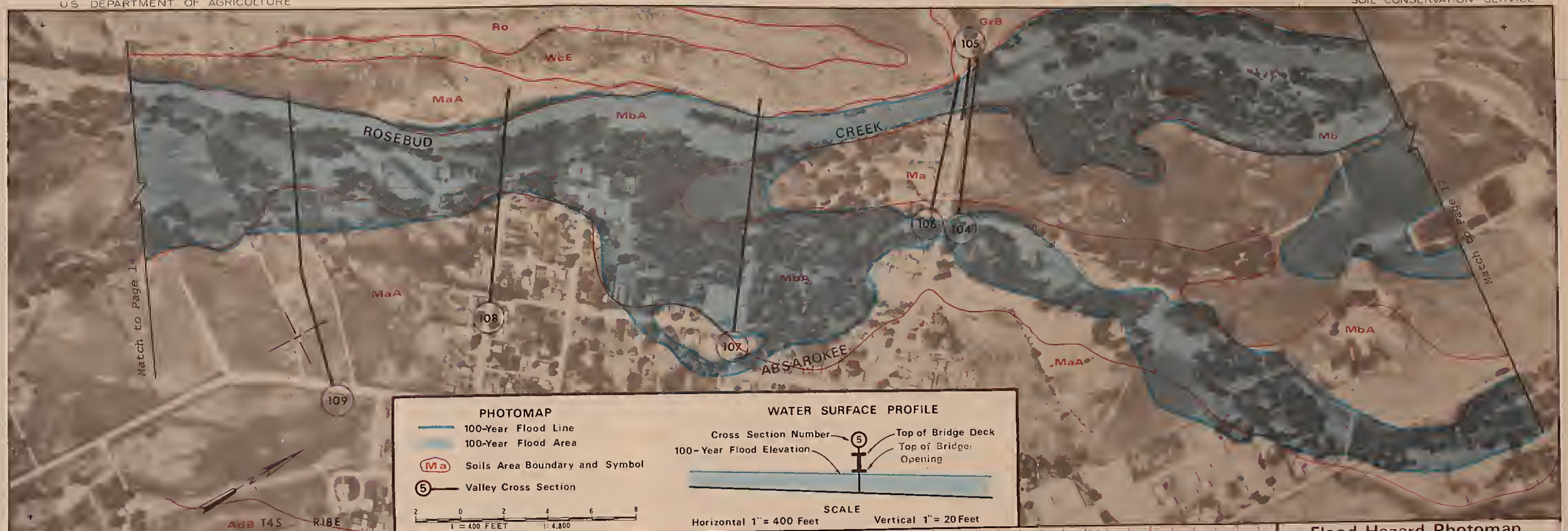
Flood Hazard Photomap and Water Surface Profiles

Stillwater River and Rosebud Creek Flood Hazard Analyses

Stillwater County, Montana

May 1974 Sheet 13 of 16





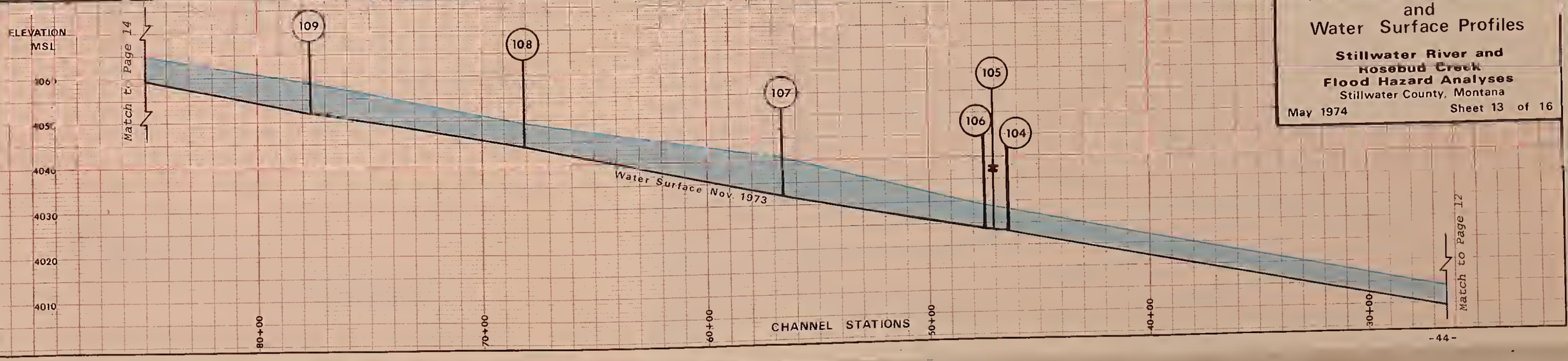
PHOTOMAP

- 100-Year Flood Line
- 100-Year Flood Area
- (Ma) Soils Area Boundary and Symbol
- (5) Valley Cross Section

2 0 2 4 6 8
1" = 400 FEET 1: 4,800

WATER SURFACE PROFILE

SCALE
Horizontal 1" = 400 Feet Vertical 1" = 20 Feet



Flood Hazard Photomap and Water Surface Profiles

Stillwater River and Rosebud Creek Flood Hazard Analyses

Stillwater County, Montana

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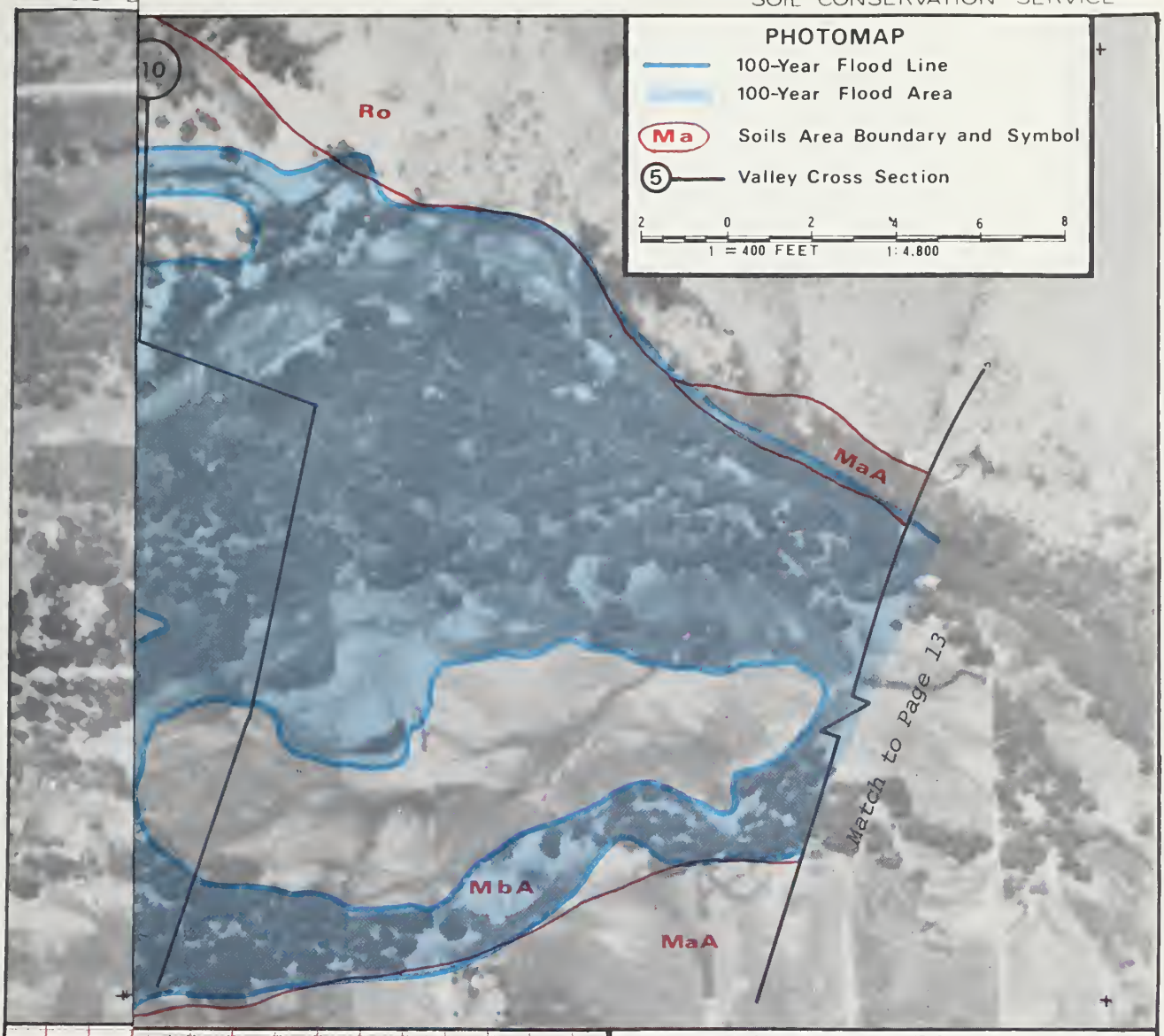
USDA – SCS – RB&WPP BOZEMAN, MONTANA – 1974



Flood Hazard Photomap and Water Surface Profiles

Stillwater River and Rosebud Creek Flood Hazard Analyses

Stillwater County, Montana

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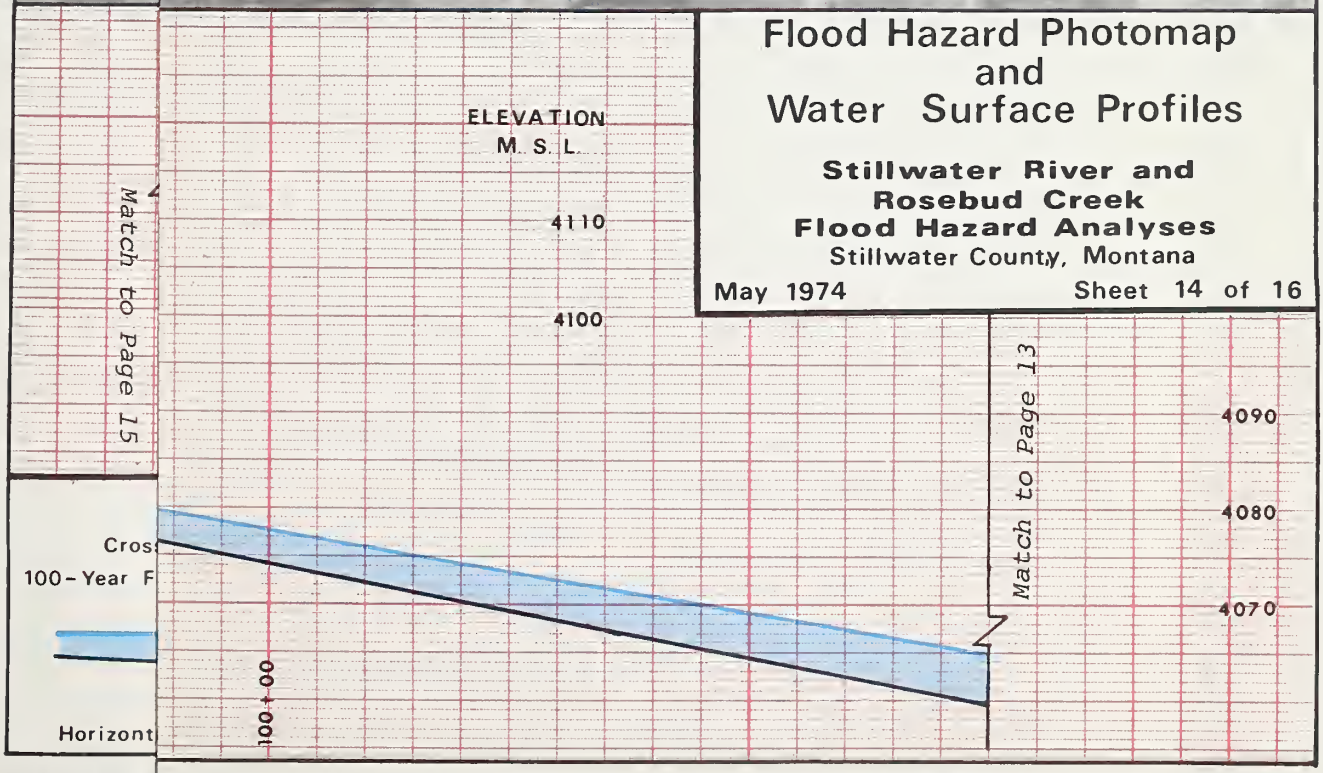
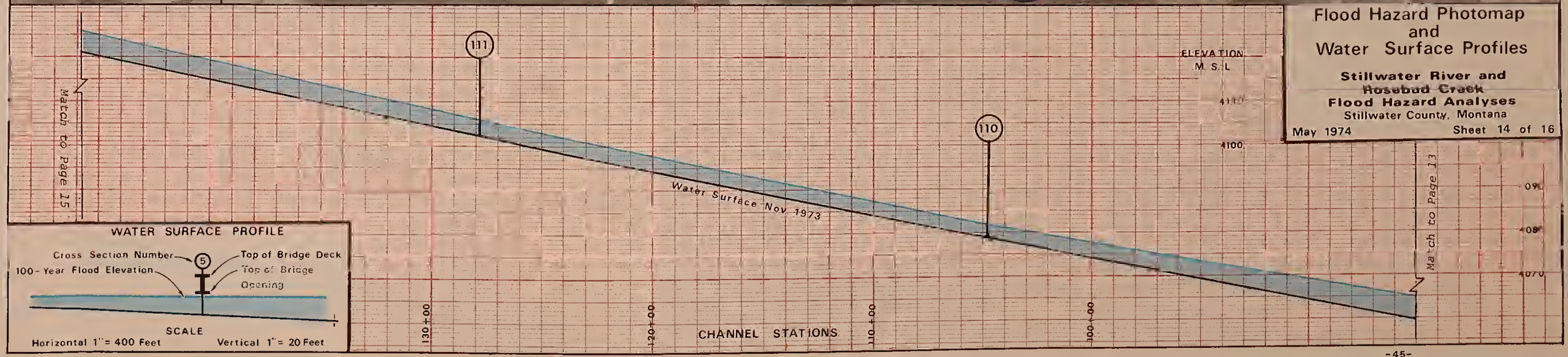


US DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE



Flood Hazard Photomap and Water Surface Profiles

Stillwater River and Rosebud Creek Flood Hazard Analyses

Stillwater County, Montana

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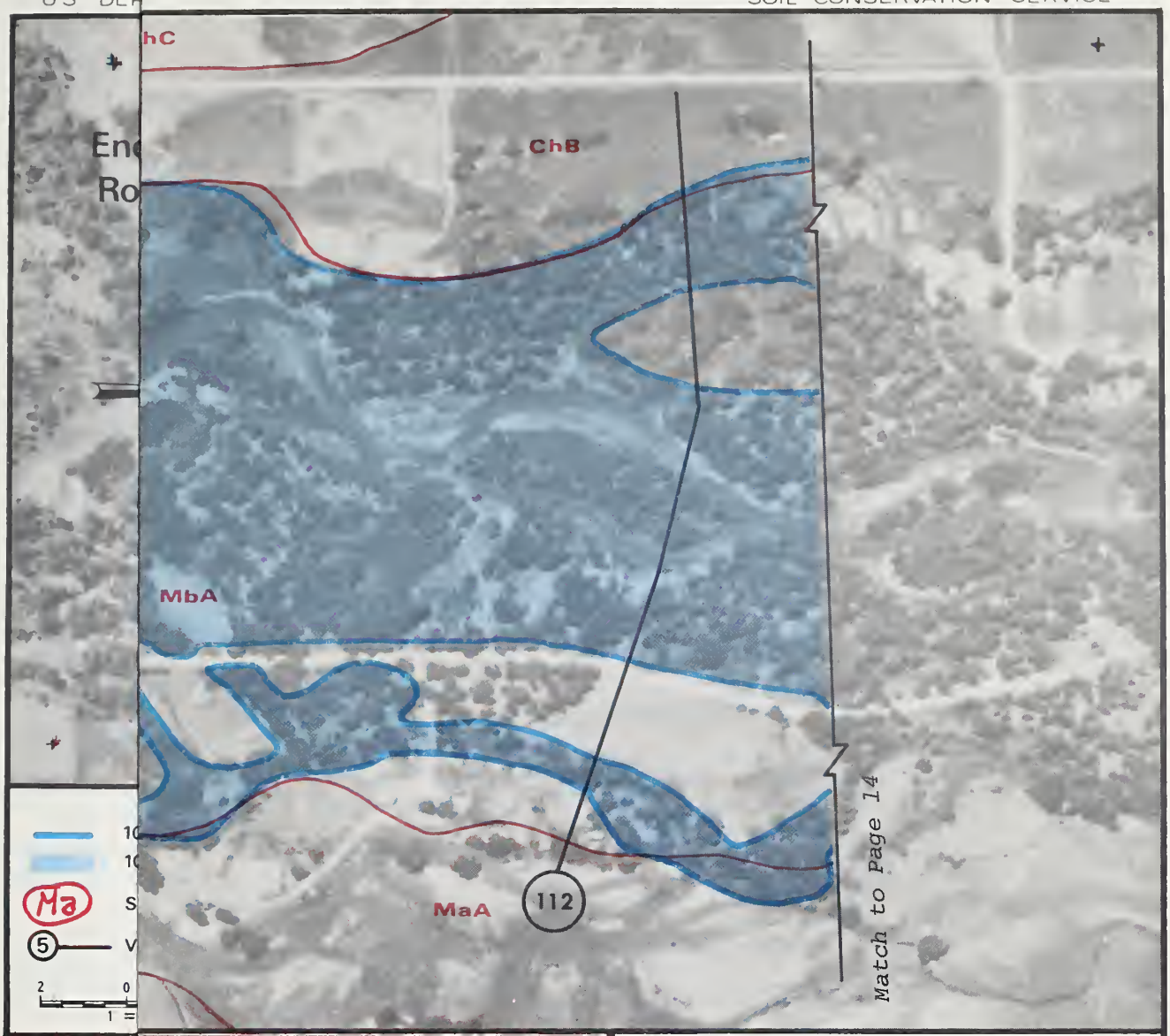

Flood Hazard Photomap and Water Surface Profiles

Stillwater River and Rosebud Creek Flood Hazard Analyses

Stillwater County, Montana

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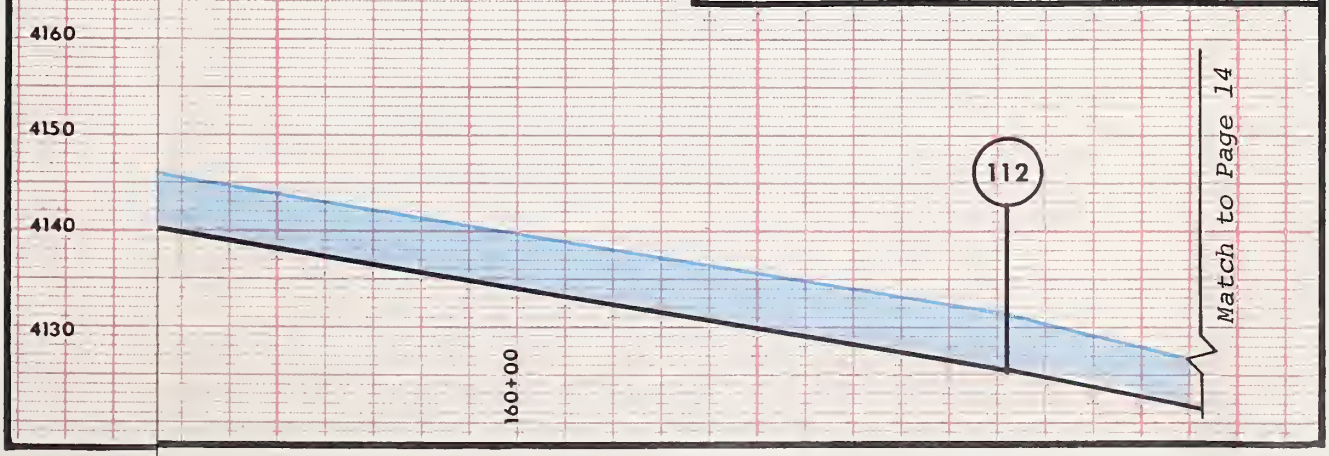
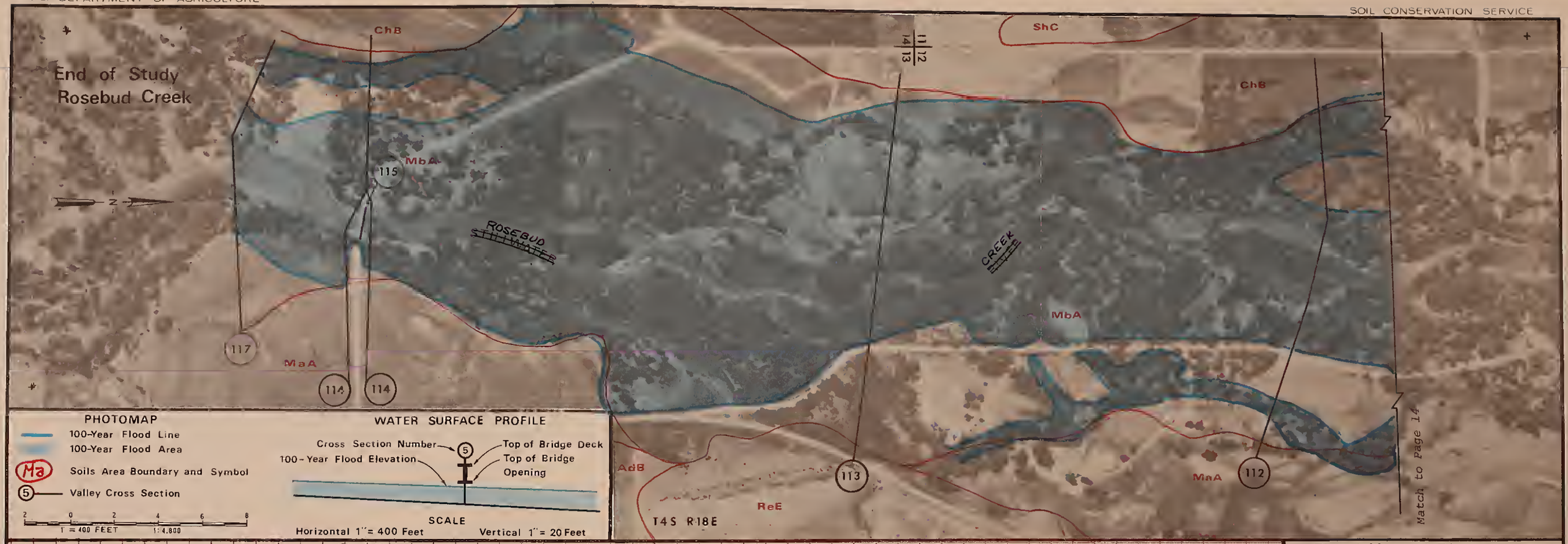




PHOTOMAP

100-Year Flood Line

100-Year Flood Area

(Ma) Soils Area Boundary and Symbol

(5) Valley Cross Section

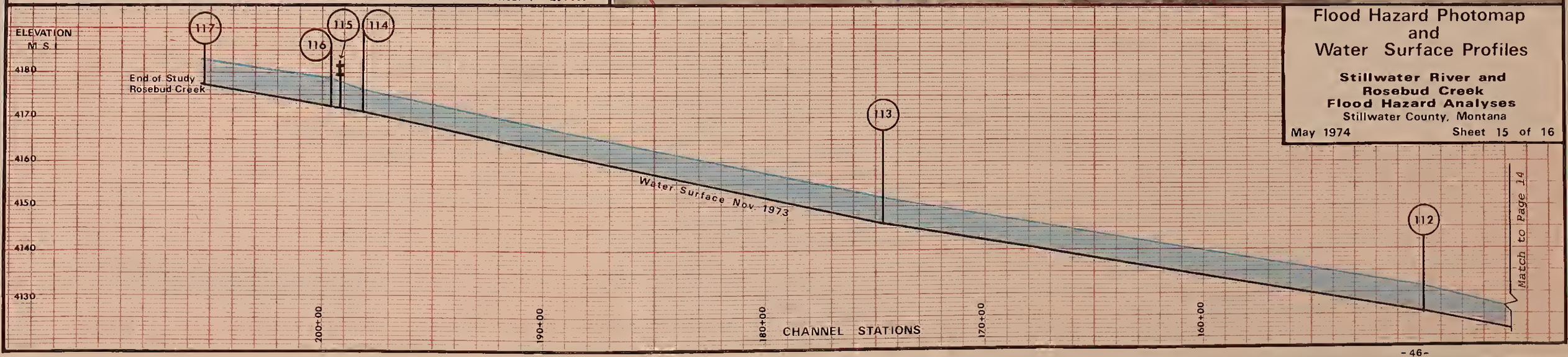
2 0 2 4 6 8

1" = 400 FEET 1:4,800

WATER SURFACE PROFILE

SCALE

Horizontal 1"= 400 Feet Vertical 1"= 20 Feet



Flood Hazard Photomap and Water Surface Profiles

Stillwater River and Rosebud Creek Flood Hazard Analyses

Stillwater County, Montana

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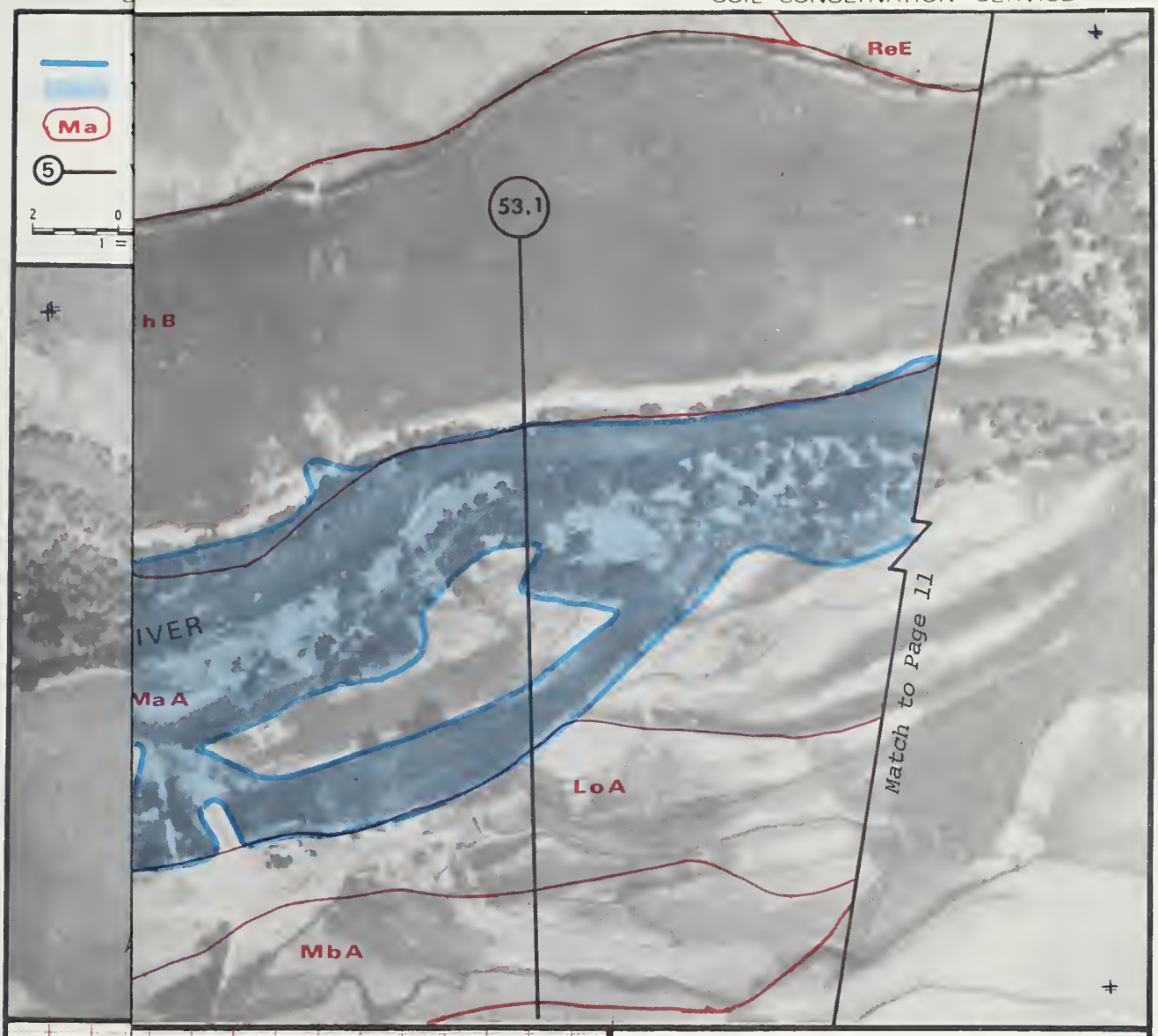
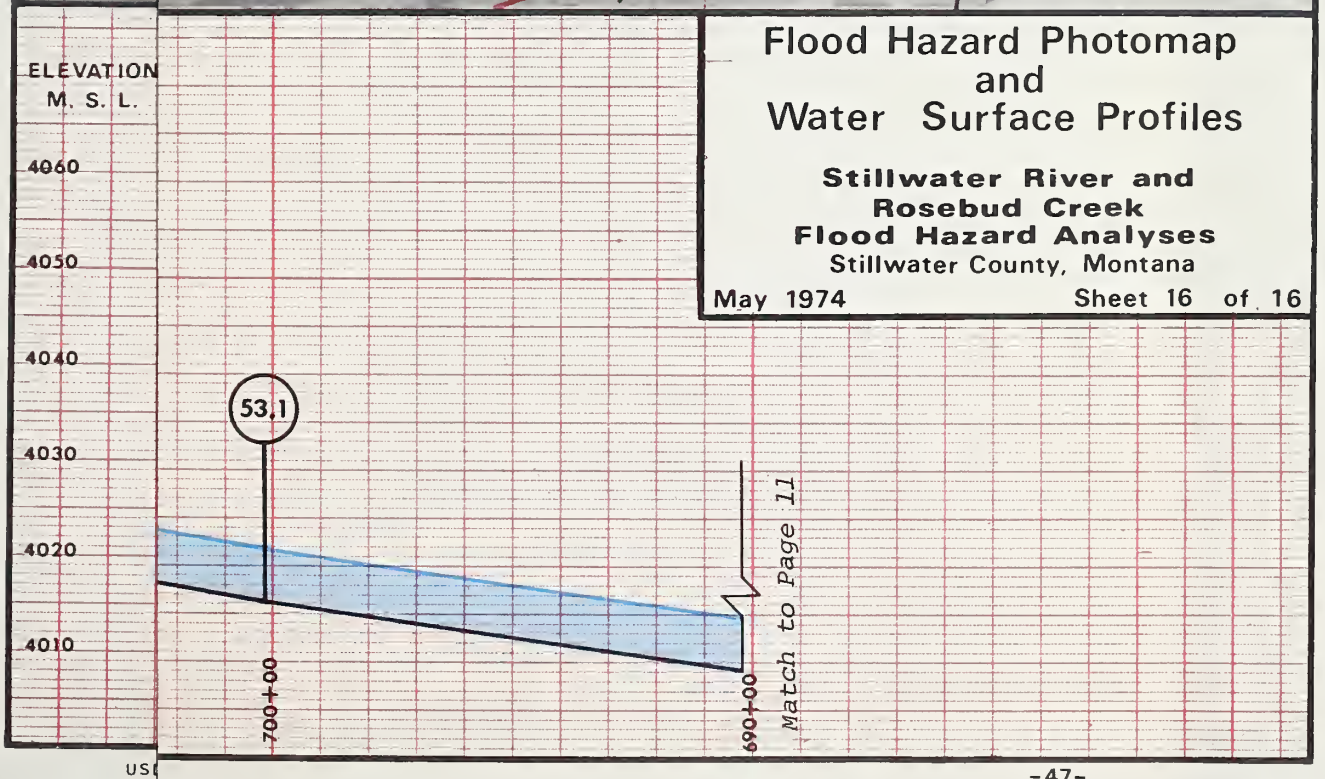




Flood Hazard Photomap and Water Surface Profiles

Stillwater River and Rosebud Creek Flood Hazard Analyses

Stillwater County, Montana

May 1974 Sheet 16 of 16

PHOTOMAP

100-Year Flood Line
100-Year Flood Area
Ma — Soils Area Boundary and Symbol
5 — Valley Cross Section

2 0 2 4 6 8
1 = 400 FEET 1:4,800

WATER SURFACE PROFILE

Cross Section Number (5)
100-Year Flood Elevation
Top of Bridge Deck
Top of Bridge Opening

SCALE
Horizontal 1" = 400 Feet Vertical 1" = 20 Feet

End of Stillwater River Analyses

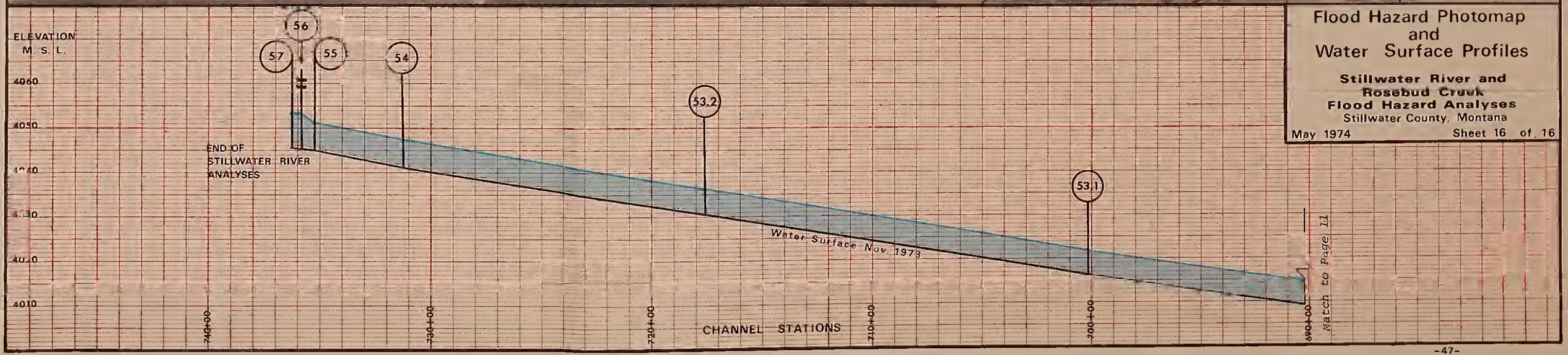
54 53.2 53.1 57 55 56 35

WoC RoE ChB MaA LoA MbA QnB

STILLWATER RIVER

Match to Page 11

T3S R18E



Flood Hazard Photomap and Water Surface Profiles

Stillwater River and Rosebud Creek Flood Hazard Analyses

Stillwater County, Montana

May 1974 Sheet 16 of 16

USDA – SCS – RB&WPP, BOZEMAN, MONTANA – 1974

APPENDIX A

Supplementary Tables and Bench Mark Documentation

TABLE 1

FLOOD FREQUENCY DISCHARGE
FOR
SELECTED CROSS SECTIONS

Cross Section Number	10-Year (cfs)	25-Year (cfs)	50-Year (cfs)	100-Year (cfs)	500-Year (cfs)
		STILLWATER RIVER			
13	8,870	10,320	11,550	12,690	15,680
18	8,760	10,160	11,380	12,600	15,440
24N	8,760	10,160	11,380	12,600	15,440
28	8,620	10,000	11,100	12,400	15,100
33	8,550	9,950	11,070	12,300	15,070
40	8,400	9,850	11,000	12,170	14,870
51	8,290	9,550	10,720	11,840	14,540
55	5,410	6,310	7,200	8,040	10,090
		ROSEBUD CREEK			
102	4,460	5,190	5,950	6,750	8,440
110	4,440	5,160	5,920	6,680	8,400
112	4,400	5,120	5,870	6,630	8,340
114	4,370	5,080	5,830	6,580	8,280

TABLE 2

FLOOD PLAIN REFERENCE DATA

STILLWATER RIVER

Cross Section Number	Channel Stationing	Low Water Surface Nov. 1973 Elevation ft. M.S.L.	10-Year Flood Crest Elevation ft. M.S.L.	25-Year Flood Crest Elevation ft. M.S.L.	50-Year Flood Crest Elevation ft. M.S.L.	100-Year Flood Crest Elevation ft. M.S.L.	500-Year Flood Crest Elevation ft. M.S.L.
*8	33+70	3591.4	3594.5	3594.7	3594.9	3595.0	3595.4
*9	56+33	3604.4	3606.8	3607.1	3607.3	3607.5	3608.0
*9.1	73+50	3613.3	3616.4	3616.7	3617.0	3617.3	3617.2
*10	81+10	3618.3	3622.9	3623.4	3623.6	3624.0	3624.5
*12	82+10	3618.5	3624.0	3624.3	3624.6	3624.7	3625.3
*12.1	91+70	3623.4	3628.5	3628.8	3629.3	3629.60	3630.3
*13	102+50	3631.5	3635.3	3635.7	3636.0	3636.3	3636.9
*14	115+54	3637.6	3643.0	3643.5	3643.9	3644.2	3644.9
*15	125+50	3642.8	3648.2	3648.7	3649.1	3649.4	3650.3
*16	146+32	3658.8	3662.4	3662.8	3663.2	3663.4	3664.1
*17	154+32	3663.0	3668.0	3668.4	3668.8	3669.0	3669.7
*18	170+38	3671.1	3676.8	3677.1	3677.5	3677.8	3678.4
19	186+40	3679.0	3684.2	3684.6	3685.0	3685.4	3686.2
*20	204+87	3691.7	3695.3	3695.6	3695.9	3696.1	3696.7

* Flood elevations shown for this section pertain only to streamflow in main channel.

TABLE 2--FLOOD PLAIN REFERENCE DATA
STILLWATER RIVER

Cross Section Number	Channel Stationing	Low Water Surface Nov. 1973 Elevation ft. M.S.L.	10-Year Flood Crest Elevation ft. M.S.L.	25-Year Flood Crest Elevation ft. M.S.L.	50-Year Flood Crest Elevation ft. M.S.L.	100-Year Flood Crest Elevation ft. M.S.L.	500-Year Flood Crest Elevation ft. M.S.L.
*21	228+02	3702.9	3708.3	3708.6	3708.8	3709.1	3609.6
*21.1	250+74	3720.3	3724.3	3724.7	3725.0	3725.3	3725.8
*22N	252+74	3722.4	3726.0	3726.4	3726.6	3726.9	3727.5
*23N	253+74	3723.0	3726.8	3727.2	3727.6	3728.0	3728.7
*24N	254+34	3723.2	3727.6	3728.0	3728.2	3728.6	3729.3
*25	274+32	3738.0	3740.8	3741.1	3741.3	3741.5	3741.9
*26	302+66	3754.5	3758.5	3758.8	3759.0	3759.2	3759.7
*27	317+51	3764.6	3766.6	3766.9	3767.2	3767.4	3768.0
*27.1	325+50	3771.8	3773.7	3773.9	3774.2	3774.4	3774.9
*28	340+86	3779.7	3785.0	3785.2	3785.5	3785.8	3786.3
*29.1	368+65	3800.0	3804.0	3804.3	3804.6	3804.7	3805.3
*30	390+65	3815.1	3820.2	3820.5	3820.8	3821.1	3821.7
*31	405+88	3824.6	3829.1	3829.3	3829.6	3829.8	3830.4
*32	426+82	3835.5	3840.4	3840.7	3840.9	3841.2	3841.7
*33	437+37	3840.4	3845.9	3846.2	3846.6	3846.9	3847.5
34	466+55	3860.7	3865.0	3865.3	3865.6	3865.9	3866.5

*Flood elevations shown for this section pertain only to streamflow in main channel.

TABLE 2--FLOOD PLAIN REFERENCE DATA
STILLWATER RIVER

Cross Section Number	Channel Stationing	Low Water Surface Nov. 1973 Elevation ft. M.S.L.	10-Year Flood Crest Elevation ft. M.S.L.	25-Year Flood Crest Elevation ft. M.S.L.	50-Year Flood Crest Elevation ft. M.S.L.	100-Year Flood Crest Elevation ft. M.S.L.	500-Year Flood Crest Elevation ft. M.S.L.
35	485+02	3874.5	3879.0	3879.4	3879.7	3879.8	3880.3
36	489+52	3876.0	3881.2	3881.5	3881.8	3882.2	3882.7
37	494+09	3877.4	3883.5	3883.8	3884.2	3884.4	3885.1
38	508+26	3887.6	3893.0	3893.4	3893.8	3894.2	3894.8
*39	523+22	3898.3	3902.0	3902.4	3902.8	3903.0	3903.6
*40	535+82	3905.7	3909.7	3910.0	3910.3	3910.7	3911.2
41	540+59	3908.7	3913.0	3913.4	3913.6	3913.9	3914.4
42	548+94	3916.5	3921.0	3921.3	3921.5	3921.8	3922.1
43	559+22	3925.0	3928.8	3929.2	3929.6	3929.9	3930.4
44	589+14	3943.0	3946.8	3947.4	3947.8	3948.2	3948.9
45	597+44	3947.0	3950.8	3951.2	3951.6	3952.0	3953.1
47	598+44	3948.3	3951.7	3952.2	3952.7	3953.2	3954.2
48	604+64	3949.8	3955.3	3955.8	3956.3	3956.6	3957.3
49	615+87	3958.3	3963.0	3963.5	3963.9	3964.2	3965.0
*50	624+53	3963.6	3968.9	3969.2	3969.6	3969.9	3970.6
*51	638+94	3971.8	3977.0	3977.5	3977.9	3978.2	3979.0

*Flood elevations shown for this section pertain only to streamflow in main channel.

TABLE 2--FLOOD PLAIN REFERENCE DATA
STILLWATER RIVER

Cross Section Number	Channel Stationing	Low Water Surface Nov. 1973 Elevation ft. M.S.L.	10-Year Flood Crest Elevation ft. M.S.L.	25-Year Flood Crest Elevation ft. M.S.L.	50-Year Flood Crest Elevation ft. M.S.L.	100-Year Flood Crest Elevation ft. M.S.L.	500-Year Flood Crest Elevation ft. M.S.L.
*52	645+84	3975.8	3981.3	3981.7	3982.1	3982.3	3982.9
52.1	661+70	3988.7	3993.4	3993.7	3994.1	3994.4	3995.0
*53	680+60	4001.9	4006.9	4007.3	4007.6	4008.0	4008.6
*53.1	700+24	4016.5	4021.2	4021.6	4021.9	4022.2	4022.9
*53.2	717+56	4030.9	4035.5	4035.9	4036.2	4036.4	4037.1
*54	731+10	4041.5	4047.0	4047.3	4047.6	4047.8	4048.3
55	735+27	4045.1	4050.2	4050.6	4050.9	4051.2	4051.8
57	736+27	4045.4	4052.0	4052.5	4052.8	4053.3	4053.9

*Flood elevations shown for this section pertain only to streamflow in main channel.

FLOOD PLAIN REFERENCE DATA

ROSEBUD CREEK

Cross Section Number	Channel Stationing	Low Water Surface Elevation ft. M.S.L.	10-Year Flood Crest Elevation ft. M.S.L.	25-Year Flood Crest Elevation ft. M.S.L.	50-Year Flood Crest Elevation ft. M.S.L.	100-Year Flood Crest Elevation ft. M.S.L.	500-Year Flood Crest Elevation ft. M.S.L.
*102	6+09	3980.5	3985.3	3985.8	3986.1	3986.4	3987.1
*103	24+20	4002.5	4006.0	4006.3	4006.5	4006.8	4007.2
*104	46+51	4023.4	4027.2	4027.6	4028.0	4028.4	4029.3
105	47+01	4023.9	4027.6	4028.2	4028.6	4029.1	4029.9
*106	47+51	4024.4	4027.6	4028.3	4028.9	4029.4	4030.1
*107	56+71	4032.4	4039.4	4039.9	4040.3	4040.7	4041.4
108	68+10	4044.1	4048.6	4049.1	4049.4	4049.7	4050.3
*109	77+75	4052.1	4057.4	4057.8	4058.1	4058.4	4059.0
*110	104+73	4079.4	4081.3	4081.5	4081.7	4081.8	4082.2
*111	127+83	4102.3	4105.9	4106.2	4106.4	4106.6	4107.1
*112	149+72	4125.3	4130.0	4130.4	4130.6	4130.9	4131.3
*113	174+70	4146.8	4150.9	4151.0	4151.3	4151.7	4152.0
*114	198+26	4172.0	4175.4	4175.8	4176.2	4176.6	4177.4
*116	199+60	4172.8	4178.2	4178.6	4179.0	4179.4	4180.1
*117	205+35	4178.60	4181.8	4182.2	4182.4	4182.7	4183.4

*Flood elevations shown for this section pertain only to streamflow in main channel.

TABLE 4

BRIDGE DATA AND FLOOD ELEVATIONS

Cross Section Number	River Channel Stationing	Identification	Stream Bed Elev. (ft.) M.S.L.	Bridge Deck Elev. (ft.) M.S.L.	100-Year Flood Crest Elev. (ft.) M.S.L.	Bridge Underclearance Relation 100-Year Flood Elev. (ft.) M.S.L.	Above	Below
			FOR STILLWATER RIVER					
11	81+60	Firemans Point	3615.0	3632.3	3624.7	3630.3	5.6	
23N	253+74	Beartooth Ranch	3715.8	3735.2	3728.0	3731.9	3.9	
46	597+94	Millers Bridge	3944.3	3958.3	3953.9	3956.5	2.6	
56	735+77	Johnson Bridge	4044.4	4061.1	4053.3	4059.7	6.4	
			FOR ROSEBUD CREEK					
105	47+01	Across Rosebud Creek in Absarokee	4020.0	4038.8	4029.1	4036.8	7.7	
115	199+16	Smith Bridge	4165.9	4182.0	4179.4	4180.5	1.1	

TABLE 5

INCREASED DEPTH-REMAINING FLOODWAY WIDTH VALUES

Valley Cross Section Number	Stream Channel Width	100-Yr. Flood Plain Width			0.5 ft. Increased Depth [2] Remaining Width			1.0 ft. Increased Depth [2] Remaining Width		
		Left [1]	Right	Total	Left	Right	Total	Left	Right	Total
	Feet									
STILLWATER RIVER										
8	200	114	2040	2354	0	1271	1471	0	613	813
9	205	840	365	1410	556	0	761	295	0	500
9.1	300	140	140	580	0	0	300	0	0	300
11	----Bridge----Not computed----									
12	172	0	800	972	0	128	300	0	35	207
12.1	155	51	252	458	0	0	155	0	0	155
13	215	68	657	940	0	257	472	0	0	215
14	190	0	660	850	0	96	286	0	0	190
15	250	0	410	660	0	0	250	0	0	250
16	220	205	251	676	0	144	364	0	0	220
17	190	352	245	787	223	0	413	0	0	190
18	325	476	0	801	43	0	368	0	0	325
19	210	190	245	645	0	0	210	0	0	210
20	175	0	515	790	Not computed					
21	145	295	20	460	266	10	421	247	0	392
21.1	270	0	1005	1275	0	856	1126	0	785	1055
24N	102	0	895	997	0	528	713	0	472	657
25	205	0	1515	1720	Not computed					
26	220	447	836	1503	386	572	1178	349	283	852
27.1	130	505	145	780	242	0	372	210	0	340
28	450	895	0	1345	756	0	1206	0	0	450

Revised 10/74

TABLE 5--INCREASED DEPTH-REMAINING FLOODWAY WIDTH VALUES (Continued)

Valley Cross Section Number	Stream Channel Width	100-Yr. Flood Plain Width			0.5 ft. Increased Depth 2/ Remaining Width			1.0 ft. Increased Depth 2/ Remaining Width		
		Left 1/	Right	Total	Left	Right	Total	Left	Right	Total
	Feet									
29.1	147	0	1340	1483	0	354	501	0	286	433
30	150	434	922	1506	49	377	576	0	310	460
31	165	0	1235	1400	0	1084	1249	0	1037	1202
32	140	1082	287	1509	458	219	817	206	173	519
33	140	920	0	1060	486	0	626	336	0	476
34	230	18	60	308	0	0	230	0	0	230
35	130	129	270	529	99	184	413	82	33	245
36	215	135	200	550	0	35	250	0	0	215
37	185	82	104	372	0	0	185	0	0	185
38	190	241	220	650	0	0	190	0	0	190
39	250	0	1700	1950	0	1090	1340	0	0	250
40	160	204	1358	1722	88	1207	1455	17	820	997
41	210	204	881	1295	40	740	990	0	707	917
42	330	0	721	979	0	611	941	0	99	429
43	160	305	570	1035	37	301	498	0	276	436
44	230	23	77	330	0	0	230	0	0	230
45	180	505	50	735	0	0	180	0	0	180
46	Bridge			Not computed						
47	180	596	90	866	0	0	180	0	0	180
48	105	200	182	487	15	125	245	15	63	183
49	250	246	24	520	0	0	250	0	0	250
50	185	0	875	1060	0	169	354	0	38	223
51	190	355	1375	1920	0	65	255	0	0	190
52	Not computed									
52.1	185	0	346	531	0	201	386	0	34	219
53	165	745	0	910	38	0	203	0	0	165
53.1	120	0	635	755	0	90	210	0	50	170
53.2	200	248	345	793	0	0	200	0	0	200

TABLE 5--INCREASED DEPTH-REMAINING FLOODWAY WIDTH VALUES (Continued)

Valley Cross Section Number	Stream Channel Width	100-Yr. Flood Plain Width			0.5 ft. Increased Depth Remaining Width [2]			1.0 ft. Increased Depth Remaining Width [2]		
		Left [1]	Right	Total	Left	Right	Total	Left	Right	Total
	- Feet -									
54	230	843	0	1073	0	0	230	0	0	230
55	205	851	0	1056	0	0	205	0	0	205
56	- - - - - - Bridge - - - - Not computed - - - - - - -									
57	182	885	0	1067	70	0	252	0	0	182
				ROSEBUD CREEK						
102	155	0	1079	1234	0	0	155	0	0	155
103	- - - - - - -Not computed- - - - - - -									
104	140	0	677	817	0	0	140	0	0	140
105	- - - - - - - Bridge - - - - - - Not computed - - - - - - - -									
106	105	0	640	745	0	0	105	0	0	105
107	90	0	1089	1179	0	307	397	0	0	90
108	140	0	260	400	0	90	230	0	0	140
109	120	0	484	604	0	281	401	0	205	325
110	185	560	1605	2350	150	301	636	0	161	346
111	125	780	1015	1920	161	170	456	69	113	307
112	320	500	250	1070	0	8	328	0	0	320
113	145	823	75	1043	195	58	398	105	0	250
114	135	620	165	920	0	26	161	0	0	135
115	- - - - - - - Bridge - - - - - - Not computed - - - - - - - -									
116	120	610	265	995	161	96	377	111	69	300
117	205	515	104	824	36	24	265	0	0	205

1/ The distances to the left and right are measured from the respective edges of the stream channel.

Revised 10/74

2/ See Figure 1, page 4.

Note: This table indicates the amount the total flood area must be restricted to cause a 0.5' and 1.0' increase in flood elevation. This reduction in floodway width is based on equal reduction in the floodway conveyance factors on both sides of the channel.

STILLWATER RIVER AND ROSEBUD CREEK FLOOD HAZARD ANALYSES
UNITED STATES COAST AND GEODETIC SURVEY BENCH MARKS
(USED FOR THIS SURVEY)

Bench Mark No. R-216
Elevation 3642.010
Description:

About 2.3 miles southwest along the dirt road leading to Red Lodge from Columbus, Stillwater County, 2 feet northwest of pole 93, 35 feet east of the center line of the road, 1 foot east of a north-and-south fence, and about 1 foot higher than the road. A standard disk, stamped "R 216 1934" and set in the top of a concrete post.

Bench Mark No. P-216
Elevation 3808.283
Description:

About 6.1 miles southwest along the dirt road leading to Red Lodge from Columbus, Stillwater County, 66 feet south of pole 236, 50 feet southeast of the center line of the road, 4 feet west of a north-and-south fence, and about 3 feet higher than the road. A standard disk, stamped "P 216 1934" and set in the top of a concrete post.

Bench Mark No. N-216
Elevation 3886.659
Description:

About 8 miles southwest along the dirt road leading to Red Lodge from Columbus, Stillwater County, about 5.9 miles northeast of the post office at Absarokee, about 115 feet southeast of the center line of the road, 88 feet southeast of a northeast-and-southwest fence, in the top of a large granite boulder, and about 10 feet higher than the road. A standard disk, stamped "N 216 1934."

Bench Mark No. M-216
Elevation 3942.758
Description:

About 9.8 miles southwest along the dirt road leading to Red Lodge from Columbus, Stillwater County, about 4.1 miles northeast of the post office at Absarokee, 54 feet southeast of the center line of the road, 6 feet northwest of a northeast-and-southwest fence, and about 5 feet higher than the road. A standard disk, stamped "M 216 1934" and set in the top of a concrete post.

Bench Mark J-216
Elevation 4064.378
Description:

About 14.3 miles southwest along the dirt road leading to Red Lodge from Columbus, Stillwater County, about 0.7 mile southeast of Absarokee, 41 feet west of the center line of the road, in a fence corner, 14 feet west of the west edge of an irrigation ditch, 2 feet east of the corner fence post, and about level with the road. A standard disk, stamped "J 216 1934" and set in the top of a concrete post.

STILLWATER RIVER AND ROSEBUD CREEK FLOOD HAZARD ANALYSES

TBM DESCRIPTIONS

TBM 1/ Number	MSL 2/ Elevation	Description
1	3626.12	On top of southwest concrete wing wall abutment for bridge across the Stillwater River at Firemans point; also first bridge across the Stillwater River south of Columbus. NW¼ Sec. 32 T2S R20E
2	3636.27	On 2"x2" angle iron on side of headwall of Don Harper's ditch headgate, on the west bank of the Stillwater River west of Shane Ranch buildings. W½ Sec. 32 T2S R20E
3	3648.32	100' south of the south boundary of Firemans point fishing access, on point of sandstone rock painted orange on west bank of Stillwater River. W½ Sec. 32 T2S R20E
4	3668.17	On 3/4" rebar in pine tree flat west side of Stillwater River across river from Iron's gabled cabin. Blaze on 12" pine tree. Iron's cabin is cabin farthest south in Dolan group. NE¼ Sec. 6 T3S R20E
5	3674.39	On round sandstone rock flush with ground. 12' northeast of 12" pine tree with blaze on brushy flat on west side of Stillwater River. Also across river from mouth of Joe Hill Creek and Lee Adsit farm buildings. SE¼ Sec. 6 T3S R20E
6	3686.56	On 15" rounded rock painted orange, 10 feet north of river bank, 10 feet east of 3 pine trees, and north of Bill Noble's buildings. SW¼ Sec. 6 T3S R20E
7	3693.59	On 24" flat sandstone rock on north bank of Stillwater River below steep bluff on gravelly flat. Also northwest of north end of island, northwest of brown cabin with gray block fireplace. SW¼ Sec. 6 T3S R20E
8	3704.42	On 3/4" rebar north side of eastwest fence on west bank of the Stillwater River, across river from pink cabin. This cabin is the one farthest north in Southerland group. NE¼ Sec. 12 T3S R19E

See footnotes on page 65.

TBM Descriptions for Stillwater River

TBM 1/ Number	MSL 2/ Elevation	Description
9	3730.56	On flat sandstone rock painted orange, near top of bluff on west bank of Stillwater River across river from Southerland cabin, also 8' over bank from field due west of white trailer cabin. NE¼ Sec. 12 T3S R19E
10	3735.16	On west end of 12" "I" beam on southwest corner of bridge farthest west of the Beartooth Hereford Ranch buildings. Center Sec. 12 T3S R19E
11	3731.72	On 90° elbow of a 4" steel pipe brace on southeast corner of the south end of the first bridge west of the Beartooth Hereford Ranch headquarters across the Stillwater River. Center Sec. 12 T3S R19E
12	3740.23	On top of southeast corner of concrete foundation of the Beartooth Hereford Ranch office building or southeast corner of window well. Center Sec. 12 T12S R19E
13	3751.64	Orange paint on sandstone rock flush with ground in old lane, 6' north of fence, 12' east of fence, 35' south of fence; 100' west of the west bank of the Stillwater River; 100' west of sandstone jetty near south end of island across river from Celia Hudson farm house. SW¼ Sec. 12 T3S R19E
14	3763.17	Top of rebar in northsouth fence line west of fence east of road on west bank of the Stillwater River one-half mile north of abandoned farmstead. West line Sec. 13 T3S R19E
15	3759.31	Orange paint on flat sandstone rock north end of rock riprap in high water channel, east of northeast corner of buggy shed at abandoned farmstead on west bank of Stillwater River, across river from Henry Van Hernst farmstead. NE¼ Sec. 14 T3S R19E
16	3773.68	Top of 15" rounded rock one-half mile south of old farmstead east edge of hay field 80' west of old gate in abandoned fence; 60' southeast of group of 5 cottonwood trees on top of gravel knob; 30' east of old side delivery hay rake. NE¼ Sec. 14 T3S R19E

See footnotes on page 65.

TBM Descriptions for Stillwater River

TBM Number [1/]	MSL Elevation [2/]	Description
17	3797.17	On steel rebar east side of 8" by 6" tie gate post at gate between Beartooth Hereford Ranch and Harlen Cook ranch north side of Stillwater River. SW¼ Sec. 14 T3S R19E
18	3764.88	On bolt in grate on Graham concrete structure on line with north and south fence. NW¼ Sec. 7 T3S R20E
19	3733.21	On top of timber plate above north abutment on bridge across Joe Hill Creek on Highway 307. NE¼ Sec. 7 T3S R20E
20	3745.69	On top of east end of 18" culvert under Highway 307. Culvert is irrigation delivery to Adsit farm. NW¼ Sec. 5 T3S R20E
21	3731.82	On top of rock painted orange on east side of Highway 307 across from gate to Adsit farmstead in center of west ½ Sec. 5 T3S R20E
22	3706.13	Top of bolt on bridge across Shane Creek on east side of Highway 307. SE¼ Sec. 32 T2S R20E
23	3799.94	On point of 24" rounded rock on north bank of the Stillwater River across from Dick Shaw's house. S½ Sec. 14 T3S R19E
24	3804.94	On top of east corner of steel gate frame for head gate of Beartooth Hereford Ranch ditch on west side of the Stillwater River at base of bluff. NE¼ Sec. 22 T3S R19E
25	3821.46	On south end of bottom step of old house foundation painted orange. 300' west of river bank. NE¼ Sec. 22 T3S R19E
26	3836.85	Top of inlet end of 15" c.m.p. north of 8' frame, south of trail at bottom of hill. NE¼ Sec. 22 T3S R19E
27	3822.14	On 12" rounded boulder flush with ground 600' south of old house foundation on north bank of the Stillwater River 12' from edge of channel, across river from Van Every buildings, north of road over hill. NW¼ Sec. 22 T3S R19E

See footnotes on page 65.

TBM Descriptions for Stillwater River

TBM Number [1/]	MSL Elevation [2/]	Description
28	3846.61	Orange circle on top of 36" round granite boulder, 40' east of clump of trees 150' east of old foundation, south end of meadow, 50' west of 20' fir tree, across river from Kennedy buildings. Center of the W½ Sec. 22 T3S R19E
29	3855.87	Orange circle on 20" granite rock, 30' east of Harlen Cook's road, 10' from north channel bank of the Stillwater River, across river from lower (north) Kennedy house. SW¼ Sec. 22 T3S R19E
31	3879.77	Orange circle on 12" rock flush with the ground 5' north of a 5' stump with 36" diameter, 100' west of gaging station cable anchor tower on west bank of the Stillwater River on north line of Sec. 28 T3S R19E
32	3897.08	Orange circle on 24" granite rock on west river bank above riprap, across river from William Gauthier buildings. Northwest corner Sec. 28 T3S R19E
33	3921.55	Orange on hinge, 300' upstream from creek past Harlen Cook's house, 600' southwest of big dead tree across river, 400' southeast of big lone cottonwood tree; 300' northeast of old grain drill. NE¼ Sec. 29 T3S R19E
34	3933.75	Hub under power line, 100' south of corner guide pole where line turns from Huffards over to Swords Barn. NE¼ Sec. 29 T3S R19E
35	3934.90	Orange circle on sandstone riprap rock on east edge of the Stillwater River, west edge of Miller's meadow, 30' downstream from a jetty. North of sheepherder's monument on hill above stockyard. On east line of Sec. 29 T3S R19E
36	3950.31	Orange circle on rock flush with ground 12" inside Miller's property line 12' south of southwest corner of chicken house at old Steinbrink farmstead north of old concrete post slab. SW corner Sec. 29 T3S R19E

See footnotes on page 65.

TBM Descriptions for Stillwater River

TBM [1] Number	MSL [2] Elevation	Description
37	3952.78	Orange circle on top of railroad tie corner post on northwest corner of road corner where road turns north towards Huntley Butte, 800' east of John Miller's house west across road from gate to Huffards farmstead. SE¼ Sec. 30 T3S R19E
38	3956.43	On orange bolt head on top of 48" pier on northeast corner of Riverside bridge. SE¼ Sec. 30 T3S R19E
39	3959.54	Orange circle on 10" rock 15' north of stone pillar gate post at first riverside cabin southeast of Olson's fish pond, south boundary Sec. 30 T3S R19E
40	3987.87	Orange circle on top of railroad tie corner post, 6 feet from county road 40' southwest of Montana Power pipe corner post. Center of south boundary of Sec. 30 T3S R19E
41	3977.70	Orange circle on top of 30" granite rock 25' east Barron's mail box on north edge of the Stillwater River. NW¼ Sec. 31, T3S R19E
42	3986.07	Orange circle on top of a 15" granite boulder on north edge of Stillwater River 200' south of the upper Huffard house, at bend in road northeast corner of Sec. 36 T3S R18E
44	3998.69	Orange circle on rock flush with the ground 12' from gate to Paul Matovick's cabin, 10' from county road. In northeast ¼ Sec. 36 T3S R18E.
45	3811.85	Silver dot on south concrete abutment wing on bridge across Whitebird Creek on secondary highway 307. SW¼ Sec. 13 T3S R20E
46	4010.86	Orange circle on granite boulder 6' east of cattle guard at gate into Shady Brook Ranch (Carter Bridges) NW¼ Sec. 36 T3S R18E
47	4022.80	Orange circle on concrete slab 400' north and across Stillwater River from Mabel Smith's cabin NW¼ Sec. 36 T3S R18E
48	4033.41	Orange circle on 24" boulder 200' northeast of brown cabin with patio and white pillars and fence west boundary Sec. 36 T3S R18E.

See footnotes on page 65.

TBM Descriptions for Stillwater River

TBM 1/ Number	MSL 2/ Elevation	Description
49	4047.86	Orange circle on 18" granite boulder on north shore of Stillwater River across from Kanuits Island. 10' east of a white post 25' northwest of Fish and Game toilet. Center Sec. 35 T3S R18E
50	4054.77	Orange circle on top of east corner of concrete headgate, 70' west of Johnson Bridge, 5' east of headgate screw jack. Center Sec. 35 T3S R18E

1/ Temporary Bench Mark (TBM)

2/ Mean Sea Level (MSL)

STILLWATER RIVER AND ROSEBUD CREEK FLOOD HAZARD ANALYSES

TBM DESCRIPTIONS FOR ROSEBUD CREEK

TBM Number [1]	MSL Elevation [2]	Description
51	3998.58	Orange circle on granite boulder in east and west fence 100' west of the Rosebud Creek, 600' southwest of an across Stillwater River from a white cabin with a green roof. NE¼ Sec. 36 T3S R18E
52	4003.10	Orange circle on 48" granite boulder in Mendenhall's meadow 500' west and across Rosebud Creek from small white house with red trim. NE¼ Sec. 36 T3S R18E
53	4008.43	Orange circle on 15" granite boulder 10' from west edge of Rosebud Creek 400' south of a steel granary, 400' north and across creek from Srigler's concrete plant, 100' northeast of gate out of Mendenhall's hay field. Center of E½ of Sec. 36 T3S R18E
54	4023.53	Orange circle on fence corner brace 6' from haystack 200' west of Rosebud Creek. SE¼ Sec. 36 T3S R18E
55	4022.31	Orange circle on 48" sandstone riprap rock, 600' downstream from bridge across Rosebud Creek at Absarokee 20' downstream from old binder. SE¼ Sec. 36 T3S R18E
56	4031.49	On 3/4" bolthead on fire hydrant by Sheep Creek, across road from pink house in Absarokee along street going east from bridge across Rosebud Creek. On north boundary Sec. 1 T4S R18E.
58	4046.94	On 3/4" bolthead on fire hydrant across street from concrete block meat shop in Absarokee. NE¼ Sec. 1 T4S R18E
60	3919.25	Orange circle on northeast corner of outlet structure of roadhouse ditch syphon under Mexican Joe Creek. NW¼ Sec. 27 T3S R19E

See footnotes on page 68.

TBM DESCRIPTIONS FOR ROSEBUD CREEK

TBM 1/ Number	MSL 2/ Elevation	Description
61	4055.03	On 3/4" bolthead on top of fire hydrant at corner of school yard next to Exxon Service Station NE¼ Sec. 1 T4S R18E.
62	4056.23	On 3/4" bolthead on fire hydrant at corner of school yard across street from Standard Service Station NE¼ Sec. 1 T4S R18E.
63	4111.72	Top of pyramid sandstone rock 4" above ground west side of secondary highway 307, 35' south west of a 3-way fence corner brace at intersection of gravel road to John Flanagan's. NW¼ Sec. 12 T4S R18E
64	4117.22	On southwest corner of a sandstone rock 2.5' by 4.5' by 5.5' 10' from the county road where the old Nitche Bridge crossed the Rosebud Creek. NW¼ Sec. 12, T4S R18E
65	4130.48	Top of 12" granite rock 4" above ground south of a lifetime metal gate by county road, 600' north of mailbox at old Rudd house. Center of SW¼ Sec. 12 T4S R18E.
66	4157.17	Top of east end of a 36" corrugated metal pipe in irrigation ditch under county road at approach to secondary highway 307. Center of NW¼ Sec. 13 T4S R18E
67	4194.46	Top of railroad rail on northeast corner of cattle guard on road off secondary 307 that goes west through C. J. Smith pasture and across the Rosebud Creek. South boundary of NW¼ Sec. 13 T4S R18E.
68	4202.71	Northwest corner of the floor of the Butcher Creek bridge on secondary highway 307 at C. J. Smith Ranch headquarters, 1' north of west railing, 100' north of mailbox SW¼ Sec. 13 T4S R18E.
69	4213.80	Northeast corner of a concrete block base for a 5' by 2" white pipe post 33' south of centerline of highway to Fishtail and 29' west of centerline of secondary highway 307, 2' east of electric power pole. SW¼ Sec. 13 T4S R18E

See footnotes on page 68.

TBM DESCRIPTIONS FOR ROSEBUD CREEK

TBM 1/ Number	MSL 2/ Elevation	Description
70	4209.47	Top of a 1½" railing on southeast corner of bridge across main east Rosebud Creek, next to L. D. S. Church, also on highway to Fishtail. S½ SW¼ Sec. 13 T4S R18E
71	4178.33	Top of 1" cable anchor rod set in concrete for gaging station tower on west bank of Rosebud Creek at Smith Bridge on south boundary of NW¼ Sec. 13 T4S R18E.
72	4162.33	Orange circle on 24" granite boulder 5' from county road 75' north of "T" in electric line 400' north of Tom Flanagan's house. SW¼ Sec. 13 T4S R18E
73	4122.85	Orange circle on 12" granite rock 70' south of the southeast corner of Moore's log house. SW¼ Sec. 12 T4S R18E

1/ Temporary Bench Mark (TBM)

2/ Mean Sea Level (MSL)

APPENDIX B

Soils

APPENDIX B

SOILS

Following are descriptions, explanation of interpretations, and Table of Interpretations of the 20 series and 23 mapping units used in this report. These units have been designated as AbD, AdB, ChB, ChC, GrB, HaA, HaB, LaB, LoA, LoB, MaA, MbA, NuA, ReE, Ro, ShC, SuE, TbE, TuA, WaB, WcE, WoC, and WoD.

The Adel, Bearmouth, Bynum, Charlos, Maurice, and Thiel series are frigid taxajuncts to their respective series. The total acres of these soils in the frigid area is small. The soil series and mapping units and soil survey maps are advance copies and are subject to change pending final correlation.

DESCRIPTION OF SERIES AND MAPPING UNITS

ABSAROKEE SERIES

The Absarokee series consists of moderately deep, well-drained soils, formed in material weathered from sandstone. They occupy upland divides and footslopes. They are underlain by bedrock at depths of 20 to 40 inches. The native vegetation is mainly bluebunch wheatgrass, western wheatgrass, rough fescue, Idaho fescue, annual forbs, and woody plants.

In a representative profile, the surface layer is dark grayish brown clay loam about 6 inches thick. The subsoil is about 17 inches thick and in two parts. The upper part is grayish brown clay loam and the lower part is grayish brown clay. The underlying material is light olive gray clay loam about 12 inches thick over hard sandstone.

Permeability is moderately slow to a depth of about 35 inches. The available water capacity is low. Reaction is neutral to a depth of about 23 inches and strongly alkaline below that depth

AbD Absarokee--Sinnigam complex, 8 to 15 percent slopes.

This complex occupies strongly sloping soils on footslopes and upland divides. About 55 percent is Absarokee clay loam and about 35 percent is Sinnigam clay loam. Absarokee clay loam occupies the swales and smooth footslopes and Sinnigam clay loam occupies the convex ridges through the mapping unit. Included in the mapping are about 10 percent of Heath and Shane soils. The Absarokee clay loam in this complex has a profile similar to that described as typical of the series, except the combined thickness of the surface and subsoil layers is about 23 inches. The Sinnigam clay loam in this complex has a profile similar to that described as typical for the series.

Surface runoff is medium and the erosion is moderate from water and wind.

Soils in this complex are suited for wheat, barley, and hay under dryland management. They are also suited for pasture and range.

ADEL SERIES

The Adel series consists of deep, well-drained soil formed in alluvium on valley floors. They occupy stream terraces and fans. The native vegetation is mainly rough fescue, Idaho fescue, columbia needlegrass, bluegrass, lupine, shrubby cinquefoil, annuals, other forbs, and woody plants.

In a representative profile, the surface layer is silty clay loam and in two parts. The upper 18 inches are black and the lower 8 inches

are dark gray. The underlying material is grayish brown and in two parts. The upper 14 inches are silty clay loam and the lower 20 inches are a heavy clay loam.

Permeability is moderate and available water capacity is high. Reaction is neutral.

AdB Adel silty clay loam, 0 to 8 percent slopes.

This nearly level to moderately sloping soil occupies stream terraces and fans. It has the profile described as typical of the series. Included in mapping are a few small areas that have a clay loam surface layer and subsoil. Small areas of Heath and Charlos soils are also included.

Surface runoff is slow or medium and the erosion hazard is moderate for water and wind.

This soil is suited for growing small grains, hay, and pasture.

BEARMOUTH SERIES

The Bearmouth series consists of deep, well-drained soils formed in material weathered from alluvium. They occupy fans and stream terraces on flood plains. They are underlain by sand and gravels at depths of 12 to 30 inches. The native vegetation is mainly bluegrass, cordgrass, willows, and deciduous and evergreen trees.

In a representative profile, the surface layer is dark grayish brown gravelly loam for a thickness of about 4 inches. The subsoil is in two parts. The upper 5 inches are dark brown gravelly loam and the lower 7 inches are brown very gravelly loam. The underlying material is pale brown very cobbly sand.

Permeability is rapid for the upper 16 inches and very rapid below. The available water capacity is very low. Reaction is neutral.

The Bearmouth soils are mapped in a complex with the Maurice soils in mapping unit MbA.

BYNUM SERIES

The Bynum series consists of moderately deep, well-drained soils formed in material weathered from sandstone and shale. They occupy uplands. They are underlain at depths of 20 to 40 inches by soft sandstone and shale material that restrict the downward movement of water and roots. The native vegetation is mainly western wheatgrass, needle-and-thread, bluebunch wheatgrass, Idaho fescue, annuals, and woody plants.

In a representative profile, the surface layer for about 7 inches is a grayish brown sandy clay loam. The subsoil is brown for 13 inches and in two parts. The upper 7 inches are a sandy clay loam and the lower 6 inches are clay loam. The underlying material is light olive gray weathered shale for about 28 inches and hard shale below.

Permeability is moderate.

The available water capacity is low. Reaction is mildly alkaline to a depth of 14 inches and moderately alkaline below that depth.

The Bynum soils are mapped in an association with the Thiel soils in mapping unit TbE.

CASTNER SERIES

The Castner series consists of shallow, well-drained soils formed in material weathered from sandstone. They occupy uplands. They are

underlain by bedrock at depths of 10 to 20 inches. The native vegetation is bluebunch wheatgrass, rough fescue, Idaho fescue, annual forbs, and woody plants.

In a representative profile, the surface layer is loam about 10 inches thick and in two parts. The upper 7 inches are dark grayish brown and the lower part is brown. The underlying material to a depth of 18 inches is light gray channery loam over hard sandstone.

Permeability is moderate. The available water capacity is very low. Reaction is neutral for 10 inches and moderately alkaline below that depth.

The Castner soils are mapped in association with the Wayden soils in mapping unit WcE.

CHARLOS SERIES

The Charlos series consists of deep, well-drained soils formed in materials weathered from glacial outwash. They occupy outwash terraces and fans and are underlain by very gravelly sand at depths of 20 to 40 inches. The native vegetation is mainly bluebunch wheatgrass, rough fescue, spike fescue, green needlegrass, Idaho fescue, thickspike wheatgrass, annuals, and deciduous and evergreen trees.

In a representative profile, the surface layer is clay loam about 6 inches thick and is in two parts. The upper 3 inches are a dark gray and the lower 3 inches are a dark grayish brown. The subsoil is in 3 parts. The upper 5 inches are dark brown clay loam. The middle 6 inches are brown clay loam and the lower 13 inches are brown very gravelly loam. The underlying material is gravelly sand.

Permeability is moderate to a depth of 30 inches and rapid below that depth. The available water capacity is low or moderate. Reaction is neutral.

ChB Charlos clay loam, 0 to 4 percent slopes

This nearly level or gently sloping soil occupies glacial outwashed terraces. It has the profile described as typical for the series. Included in mapping are a few small areas that have a loam surface layer. Also included are few small areas with cobble and stone on the surface and clay loam underlying material.

Surface runoff is medium and the erosion hazard slight or moderate from water and moderate from wind.

In some places part of the delineated units identified as this soil is flooded by the 100-year frequency flood. See the flood plain map to determine which areas of this soil are subject to flooding during the 100-year frequency flood.

This soil is suited for growing irrigated and nonirrigated crops and pasture. It is also suited for range.

ChC Charlos clay loam, 4 to 8 percent slopes

This moderately sloping soil occupies glacial outwashed terraces. It has a profile similar to that described as typical for the series. Included in mapping are a few small areas having lesser and greater slopes. Also included are small areas that have a loam surface layer. Small areas of Thiel and Heath soils are also included.

Surface runoff is medium and the water and wind erosion hazard is moderate.

This soil is suited for growing nonirrigated and irrigated wheat, barley, oats, and hay.

GRAIL SERIES

The Grail Series consists of deep, well-drained soils formed in alluvium of mixed mineralogy. They occupy footslopes, fans, and stream terraces. The native vegetation is bluegrass, rough fescue, spike fescue, thickspike wheatgrass, cordgrass, annuals, and woody plants.

In a representative profile, the surface layer is dark grayish brown clay loam about 13 inches thick. The subsoil is grayish brown clay loam about 12 inches thick. The underlying material is light brownish gray silty clay loam.

Permeability is moderately slow. The available water capacity is moderate or high. Reaction is neutral to a depth of 25 inches and moderately alkaline below that depth.

GrB Grail clay loam, 0 to 4 percent slopes

This nearly level or gently sloping soil occupies fans and footslopes along valley sides. It has the profile described as typical for the series. Included in mapping are a few small areas with steeper slopes. Also included are small areas that have a silty clay loam surface layer. Small areas of Work and Lohler soils are also included.

Surface runoff is medium and erosion hazard is moderate from wind and water.

This soil is suited for growing wheat, barley, and hay under dry farm management. Under irrigation it is also suited for wheat, barley, oats, and hay. It is also well suited for pasture and range.

HAVRELON SERIES

The Havrelon series consists of deep, well-drained soils formed in alluvium of mixed mineralogy. They occupy stream terraces and fans. The native vegetation is mainly western wheatgrass, green needlegrass, prairie junegrass, blue grama, bluegrass, forbs, and deciduous and evergreen trees.

In a representative profile, the surface layer is light gray loam about three inches thick. The underlying material for 48 inches is light brownish gray silt loam over stratified silts, very fine sandy loam, and clay loam.

Permeability is moderate. The available water capacity is high. Reaction is moderately alkaline to depths greater than 60 inches.

HaA Havrelon loam, 0 to 2 percent slopes

This nearly level soil occupies low stream terraces and fans. It has the profile described as typical for the series. Included in mapping are a few areas where the surface layer is silt loam. Small areas of Lohler soils are also included.

Surface runoff is slow and the erosion hazard is moderate from wind and slight from water.

In some places all or part of the delineated units identified as this soil is flooded by the 100-year frequency flood. See the flood plain map to determine which areas of this soil are subject to flooding during the 100-year frequency flood.

This soil is suited for irrigated and nonirrigated crops and pasture. It is also suited for range.

HaB Havrelon loam, 2 to 4 percent slopes

This gently sloping soil occupies stream terraces and fans. It has a profile similar to that described as typical for the series except it occupies stronger sloping landscapes. Included in mapping are a few small areas having lesser and steeper slopes. Also included are small areas having silt loam surface layer. Small areas of Lohler soils are also included.

Surface runoff is medium and the erosion hazard is moderate from wind and water.

This soil is suited for growing irrigated and nonirrigated crops and pasture. It is also suited for range.

LARIM SERIES, COLD VARIANT

Larim series, cold variant, consists of deep, well-drained soils formed in material weathered from alluvium. They occupy edges of stream terraces. They are underlain by sand and gravel at depths of 10 to 20 inches. The native vegetation is prairie junegrass, western wheatgrass, bluegrass, annual forbs, and woody plants.

In a representative profile, the surface layer is light grayish brown very gravelly loam about 6 inches thick. The subsoil is brown very gravelly loam about 6 inches thick. The underlying material for greater than 60 inches is well-graded sand and gravel.

Permeability is moderate to about 12 inches and very rapid below. The available water capacity is very low. Reaction is neutral.

LaB Larim very gravelly loam, cold variant, 0 to 8 percent slopes

This nearly level to moderately sloping soil occupies stream

terrace edges. It has the profile described as typical of the series. Included in mapping are small areas that have sand and gravel at depths greater than 20 inches. Small areas of Fort Collins and Wanetta soils are also included.

Surface runoff is slow and the erosion hazard from wind and water is slight.

This soil is used mainly for pasture or range.

LOHLER SERIES

Lohler series consists of deep, well-drained soils formed in alluvium of mixed mineralogy. They occupy fans and stream terraces. The native vegetation is mainly western wheatgrass, bluegrass, rough fescue, sedges, brome grass, shrubs, forbs, and deciduous and evergreen trees.

In a representative profile, the surface layer is dark grayish brown clay loam about 2 inches thick. The underlying material is in 3 parts. The upper 7 inches are grayish brown clay loam. The middle 7 inches are brown clay, and the lower 44 or more inches are olive gray clay.

Permeability is moderately slow. The available water capacity is moderate or high. Reaction is neutral to 16 inches and moderately alkaline below that depth.

LoA Lohler clay loam, 0 to 2 percent slopes

This nearly level soil occupies terraces and fans. It has the profile described as typical for the series. Included in mapping are

small areas that have a silty clay loam surface layer. Small areas of Havrelon soils are also included.

Surface runoff is slow and erosion hazard is moderate from wind and slight from water.

In some places all or part of the delineated units identified as this soil is flooded by the 100-year frequency flood. See the flood plain map to determine which areas of this soil are subject to flooding during the 100-year frequency flood.

This soil is suited for irrigated and nonirrigated crops and pasture. It is also suited for range.

LoB Lohler clay loam, 2 to 4 percent slopes

This gently sloping soil occupies terraces and fans. It has a profile similar to that described for the series. Included in mapping are small areas that have silty clay loam surface layers and clay or clay loam underlying material. Small areas of Havrelon and Work soils are also included.

Surface runoff is medium and the erosion hazard moderate from water and slight from wind.

This soil is suited for growing wheat, barley, oats, and hay under dry farm management. Under irrigation it is also suited for growing hay, wheat, barley, and oats. It is also well suited for pasture and range.

MAURICE SERIES

The Maurice series consists of deep, well-drained soils formed in materials weathered from alluvium. They occupy stream terraces. They

are underlain by sand and gravel at depths 10 to 20 inches. The native vegetation is mainly bluegrass, basin wildrye, sedges, rough fescue, annual forbs, woody plants, and some deciduous and evergreen trees.

In a representative profile the surface layer is dark grayish brown very gravelly loam about 13 inches thick. The subsoil is dark brown very gravelly fine sandy loam about 11 inches thick. The underlying material is light brownish gray very gravelly fine sandy loam.

Permeability is rapid to about 13 inches and very rapid below. The available water capacity is very low. Reaction is neutral.

MaA Maurice very cobbly loam, 0 to 2 percent slopes

This nearly level soil occupies stream terraces. It has a profile similar to that described as typical for the series except that it has a very cobbly loam surface layer. Included in mapping are small areas with very gravelly loam or cobbly loam surface layers. Also included are small, somewhat poorly and poorly drained areas. Small areas of Charlos and Bearmouth soils are also included.

Surface runoff is slow and erosion hazard from wind is slight and erosion hazard from water is slight or moderate.

In some places all or part of the delineated units identified as this soil is flooded by the 100-year frequency flood. See the flood plain map to determine which areas of this soil are subject to flooding during the 100-year frequency flood.

This soil is suited for irrigated native pasture.

MbA Maurice-Bearmouth complex, 0 to 2 percent slopes

This soil complex comprises nearly level soils on stream terraces and flood plains. About 65 percent is Maurice very gravelly loam and about 30 percent is Bearmouth gravelly loam. Maurice soils occupy swales or concave areas and the Bearmouth soils occupy convex areas and edges of terraces. Included in mapping are a few small gravel bars, a few small areas that are somewhat poorly and poorly drained. Also included are about 5 percent Charlos and Lohler soils.

The Maurice and Bearmouth soils have profiles similar to the ones described as typical for their series.

During the summer months the water table is near the surface.

Surface runoff is slow and the erosion is slight from wind and water.

In some places all or part of the delineated units identified as this soil is flooded by the 100-year frequency flood. See the flood plain map to determine which areas of this soil are subject to flooding during the 100-year frequency flood.

The soils in this unit are suited for pasture and range.

NUNN SERIES, COLD VARIANT

The Nunn series, cold variant, consists of deep, well-drained soil formed in alluvium from silty shales of mixed mineralogy. They occupy fans, stream terraces, and footslopes. The native vegetation is mainly western wheatgrass, green needlegrass, prairie junegrass, needle-and-thread, bluegrass, blue grama, threadleaf sedge, annual forbs, and woody plants.

In a representative profile, the surface layer is grayish brown clay loam about 6 inches thick. The subsoil is in two parts. The upper 12 inches are dark grayish brown clay loam and the lower 6 inches are pale brown clay. The underlying material is pale brown silty clay loam.

Permeability is moderately slow and available water capacity is moderate. Reaction is mildly alkaline to a depth of about 18 inches and moderately alkaline below that depth.

NuA Nunn clay loam, cold variant, 0 to 2 percent slopes

This moderately sloping soil occupies stream terraces and fans. It has a profile similar to that described as typical for the series. Included in mapping are small areas that have silty clay loam surface layer and subsoil. Also included are small areas having lesser and greater slopes. Small areas of Fort Collins and Wanetta soils are also included.

Surface runoff is medium and erosion hazard is moderate from water and slight from wind.

This soil is suited for growing irrigated and nonirrigated crops and pasture. It is also suited to range.

RENTSAC SERIES

The Rentsac series consists of shallow, well-drained soils formed in material weathered from sandstone. They occupy uplands. They are underlain by bedrock at depths from 10 to 20 inches. The native vegetation is bluebunch wheatgrass, western wheatgrass, prairie junegrass, blue grama, annual forbs, and woody plants.

In a representative profile, the surface layer is grayish brown loam about 8 inches thick. The underlying material is in two parts. The upper 4 inches are light brownish gray very channery loam and the lower 6 inches are light gray channery loam over hard sandstone.

Permeability is moderately rapid and available water capacity is very low. Reaction is mildly alkaline to a depth of about 8 inches and moderately alkaline below that depth.

ReE Rentsac-Wayden Association, steep

This association comprises 60 percent Rentsac channery loam and 20 percent Wayden clay loam and 5 percent sandstone outcrops and ledges or cliffs. Slopes are 15 to 50 percent. Each soil has a profile similar to that described as typical for the series. Rentsac soils occupy the smooth ridges and bench areas. Wayden soils occupy the barren shale areas. Included in mapping are about 15 percent Tanna, Sinnigam, Lambeth, and Cabba soils and about 5 percent rock outcrop.

Surface runoff is rapid and erosion hazard is moderate from water and slight from wind.

The soils in this association are used mainly for range.

Ro Rock outcrop

This unit consists of very steep barren or nearly barren areas of rock outcrop that occur throughout the county. About 10 percent of the surface supports a vegetation of trees, shrubs, and grasses. Rockland has no value for grazing.

SHANE SERIES

The Shane series consists of moderately deep, well-drained soils formed in clay alluvium of mixed mineralogy. They occupy upland footslopes and stream terraces. They are underlain at depths of 20 to 40 inches by soft clay shale. The native vegetation is western wheatgrass, Idaho fescue, rough fescue, Idaho fescue, bluebunch wheatgrass, annual forbs, and woody plants.

In a representative profile, the surface layer is in two parts. The upper 3 inches are a dark grayish brown clay and the lower 2 inches are light brownish gray clay. The subsoil for about 15 inches is dark grayish brown clay. The underlying material is in two parts. The upper 10 inches are olive gray clay and below 30 inches deep is olive clay shale.

Permeability is slow and available water capacity is low. Reaction is neutral to about 30 inches and moderately alkaline below that depth.

ShC Shane clay, 4 to 8 percent slopes

This moderately sloping soil occupies upland footslopes and stream terraces. It has the profile described as typical for the series. Included in mapping are small areas where the surface layer is a silty clay loam. Small areas of Absarokee and Heath are also included.

Surface runoff is medium and erosion hazard is moderate from wind and moderate from water.

This soil is suited for growing wheat, barley, oats, and hay under dry farm management. It is also suited for pasture and range.

SINNIGAM SERIES

The Sinnigam series consists of shallow, well-drained soils formed in material weathered from hard sandstone. They occupy uplands. They are underlain by bedrock at depths from 10 to 20 inches. The native vegetation is mainly bluebunch wheatgrass, Idaho fescue, rough fescue, bluegrass, annual forbs, and woody plants.

In a representative profile, the surface layer is grayish brown about 5 inches thick. The subsoil is grayish brown channery silty clay about 13 inches thick over hard sandstone and shale.

Permeability is moderately slow and available water capacity is very low. Reaction is neutral to 18 inches.

The Sinnigam soils are mapped in a complex with the Absarokee soils in mapping unit AbD.

SUNUP SERIES

The Sunup series consists of shallow, well-drained soils formed in material weathered from sandstone. They occupy uplands. They are underlain by bedrock at depths of 10 to 20 inches. The native vegetation is mainly bluebunch wheatgrass, prairie junegrass, Indian ricegrass, prairie sandreed grass, annual forbs, and woody plants.

In a representative profile, the surface layer is brown channery loam, about 8 inches thick. The underlying material is light gray very channery loam about 10 inches thick over hard gray sandstone.

Permeability is moderate and available water capacity is very low. Reaction is moderately alkaline to a depth of about 20 inches.

SuE Sunup-Wayden association, steep

This association is composed of 55 percent Sunup soils and 40 percent Wayden soils. Slopes are 10 to 50 percent. Each soil has a profile similar to that described as typical for the series. Sunup soils occupy the upper part of the slopes and ridge tops; Wayden soils occupy the lower part of the slopes. Included in mapping are about 5 percent Wormser and other soils and rock outcrops.

Surface runoff is rapid and erosion hazard from water severe and slight from wind.

The soils in this association are used mainly for range.

THIEL SERIES

The Thiel series consists of deep, well-drained soils formed in alluvium from glaciated outwashed material. They occupy glaciated outwash terraces and fans. They are underlain by sand and gravel at

depths of 20 to 40 inches. The native vegetation is bluebunch wheatgrass, bluegrass, spike fescue, rough fescue, Idaho fescue, annual forbs, and woody plants.

In a representative profile, the surface layer is brown clay loam about 3 inches thick. The subsoil is a dark yellowish brown very cobbly clay loam about 7 inches thick. The underlying material is in two parts. The upper 10 inches are very cobbly clay loam over coarse sand, cobbles, and gravels.

Permeability is moderate to a depth of 20 inches and rapid below that depth. The available water capacity is moderate. Reaction is neutral to a depth of 10 inches and moderately alkaline below that depth.

TbE Thiel-Bynum association, steep

This soil association comprises 60 percent hilly Thiel cobbly clay loam and 30 percent moderately steep to very steep Bynum sandy clay loam. Thiel soils have a profile similar to that described as typical for the series. Bynum soils have the profile described as typical for the series. Thiel soils occupy the terrace edges and upper part of the slope, and Bynum soils occupy the lower part of the steep slopes. Included in mapping are about 10 percent other soils--the main ones being Charlos and Heath soils.

Surface runoff is rapid and erosion hazard from water is severe and slight from wind.

The soils in this association are used mainly for range.

TuA Typic Ustifluvent, 0 to 4 percent slopes

This land type occupies nearly level or gently sloping partly filled stream channels, oxbows, stream terraces, and terrace edges

on and adjacent to flood plains. The soils are mostly deep loams, clay loams, gravelly loams and cobbly or stony loams. Very fine sand, coarse sand, and fine to coarse gravel deposits occur throughout the unit, but they are most prominent along the active streams. The vegetation is mainly western wheatgrass, green needlegrass, prairie junegrass, blue grama, forbs, shrubs, and cottonwood trees.

The soils are mostly moderately permeable and have a moderate available water capacity.

The hazard of erosion is slight or moderate from both wind and water.

In some places all or part of the delineated units identified as this soil is flooded by the 100-year frequency flood. See the flood plain map to determine which areas of this soil are subject to flooding during the 100-year frequency flood.

These soils are mainly used for pasture and range.

WANETTA SERIES, COLD VARIANT

The Wanetta series, cold variant, consists of deep, well-drained soils formed in material weathered from alluvium. They occupy terraces. They are underlain by sand and gravel at depths of 20 to 40 inches. The native vegetation is mainly bluegrass, prairie junegrass, blue grama, basin wildrye, western wheatgrass, annual forbs, and woody plants.

In a representative profile, the surface layer is loam and in two parts. The upper 4 inches are grayish brown and the lower 5 inches are brown. The subsoil is brown clay loam about 9 inches thick. The underlying material for about 10 inches is grayish brown clay loam over loose sand and gravel.

Permeability is moderate to about 28 inches and rapid below. The available water capacity is moderate. Reaction is neutral to 18 inches and moderately alkaline below that depth.

WaB Wanetta loam, cold variant, 2 to 4 percent slopes

This gently sloping soil occupies stream terraces and fan terraces. It has a profile similar to that described as typical for the series. Included in mapping are small areas where sand and gravel is at depths of 40 to 60 inches. Small areas of Larim and Fort Collins soils are also included.

Surface runoff is medium and erosion hazard from water is moderate and slight from wind.

This soil is suited for growing irrigated and nonirrigated crops and pasture. It is also suited for range.

WAYDEN SERIES

The Wayden series consists of shallow, well-drained soils formed in material weathered from shale. They occupy uplands. They are underlain by bedrock at depths of 10 to 20 inches. The native vegetation is bluebunch wheatgrass, western wheatgrass, rough fescue, big bluegrass, Idaho fescue, annual forbs, and woody plants.

In a representative profile, the surface layer is dark grayish brown clay loam about 6 inches thick. The underlying material is in two parts. The upper 8 inches are light brown gray clay loam and the lower 6 inches are weathered clay shale over hard clay shale.

Permeability is slow and the available water capacity is very low. Reaction is mildly or moderately alkaline to 20 inches.

WcE Wayden-Castner association, steep

This soil association comprises about 65 percent moderately steep and steep Wayden clay loam and 30 percent strongly sloping Castner loam. The Wayden soil has a profile similar to that described as typical for its series. Wayden soils occupy the lower part of the slope. The Castner soil has the profile like that described as typical for the series. Castner soils occupy the upper part of the slope and ridges. Included in mapping are about 5 percent other soils and rock outcrops. The main soils inclusions are Heath and Thiel soils. Also included are areas of Castner soils that have up to 15 percent channers on the surface.

Surface runoff is rapid and erosion hazard is slight from wind and moderate from water.

The soils in this association are used mainly for range.

WORK SERIES

The Work series consists of deep, well-drained soils formed in alluvium from silty shales of mixed mineralogy. They occupy fans and footslopes. The native vegetation is mainly basin wildrye, western wheatgrass, Idaho fescue, rough fescue, annual forbs, and woody plants.

In a representative profile, the surface layer is grayish brown clay loam about 5 inches thick. The subsoil is silty clay loam and in two parts. The upper 11 inches are dark grayish brown and the lower 12 inches are brown. The underlying material is very pale brown gravelly clay loam.

Permeability is moderate and available water capacity is high. Reaction is neutral to a depth of about 16 inches and moderately alkaline below that depth.

WoC Work loam, 2 to 8 percent slopes

This gently and moderately sloping soil occupies fans and footslopes on uplands. It has the profile described as typical for the series. Included in mapping are small areas that have a cobbly loam surface layer and silty clay loam subsoil. Small areas of Absarokee and Amherst soils are also indluded.

Surface runoff is medium and erosion hazard is moderate from water and slight from wind.

This soil is suited for growing irrigated and nonirrigated crops and pasture. It is also suited for range.

WoD Work loam, 8 to 15 percent slopes

This strongly sloping soil occupies fans and footslopes of the uplands. It has a profile similar to that described as typical for the series. Included in mapping are a few small areas of steeper slopes. Small areas of Absarokee and Amherst soils are also included.

Surface runoff is rapid and erosion hazard from water is moderate and slight from wind.

This soil is suited for growing wheat, barley, and hay under dry farm management. It is also suited for pasture and range.

INTERPRETATIONS OF SOILS

Interpretations are given in Table 6 for a number of uses. The ratings do not apply to small areas of highly contrasting soils within a mapping unit. For this reason the interpretations will not eliminate the need for on-site investigations and testing for specific design and construction. The interpretations can, however, be useful in general land use planning, in assessing hazards and development problems, in comparing different areas for a specific use, and in planning more detailed investigations at selected sites. Interpretations are based on the upper five feet of soil material in its natural state unless otherwise stated.

For some of the interpretations in Table 6, soil limitations are indicated by the ratings slight, moderate, and severe. Slight means soil properties generally are favorable for the use or limitations are minor and easily overcome. Moderate means that some soil properties are limiting, but can be overcome or modified by special planning and design. Severe means soil properties are so limiting that to correct or overcome them requires major soil reclamation or special design. For other uses, such as topsoil, suitability is rated by the terms good, fair, and poor, which have meanings approximately parallel to the terms slight, moderate, and severe. For other uses, no rating is given, but important soil features to be considered in planning, installation, or maintenance are listed. Where ratings such as moderate, severe, fair, or poor are used, the main limiting features are given by number (some are in percent slope). Definition of limiting soil features indicated by numbers are listed on page 98.

Following are explanations of the selected uses listed in the interpretation table (pages 99 and 100):

Cropland--The limitations of soils for cropland are based on the capacity of the soil to produce, without excessive soil deterioration, economically acceptable yields of crops commonly grown in the area. Droughtiness, wetness, erosion hazard, workability, slope, and soil patterns are items considered in evaluating the soils for cropland.

Septic Tank Absorption Fields--Septic tank absorption fields are subsurface systems of tile or perforated pipe that distribute effluent from a septic tank into natural soil. The soil material from a depth of 24 inches to five feet is evaluated. The soil properties considered are those that affect both absorption of effluent and construction and operation of the system. Properties that affect absorption are permeability, depth to water table or rock, and susceptibility to flooding. Slope is a soil property that affects difficulty of layout and construction and also the risk of soil erosion, lateral seepage, and downslope flow of effluent. Large rocks or boulders increase construction costs.

Sewage Lagoons--Sewage lagoons are shallow ponds constructed to hold sewage within a depth of two to five feet long enough for bacteria to decompose the solids. A lagoon has a nearly level floor. The sides, or embankments, are of soil material compacted to medium density. The pond is protected from flooding. Soil properties are considered that affect the pond floor and the embankment. Those that affect the pond floor are permeability, organic matter, depth to gravel, and slope. The

soil properties that affect the embankment are the engineering properties of the embankment material that influence the ease of excavation and compaction.

Shallow Excavations--Shallow excavations are those that require digging or trenching to a depth of less than six feet; for example, excavations for pipelines, sewer lines, phone and power transmission lines, basements, open ditches, and cemeteries. Desirable soil properties are good workability, moderate resistance to sloughing, gentle slopes, absence of rock outcrops or big stones, and freedom from flooding or a high water table.

Dwellings--Dwellings, for which the soils are given limitation ratings are those not more than three stories high and that are supported by foundation footings placed in undisturbed soil. The features that affect the rating of a soil for such dwellings are those that relate to capacity to support load and resist settlement under load. Soil properties that affect capacity to support load are wetness, susceptibility to flooding, density, plasticity, texture, frost action potential, and shrink-swell potential. Those that affect excavation are wetness, slope, and content of stones and rocks. (On-site investigations are needed for interpretations relevant to detailed design of foundations and to specific placement of buildings.)

Local Roads and Streets--Local roads and streets for which soil ratings are given have an all-weather surface expected to carry automobile traffic. Roads and streets should have a subgrade consisting of

gravel, crushed rock, or compacted soil material with a surface of gravel, asphalt, or concrete. They are graded to shed water and have provisions for drainage.

Soil properties that most affect design and construction of roads and streets are load-supporting capacity, stability of the subgrade, and the workability and quantity of cut-and-fill material available. Wetness and flooding affect stability of the material. Slope, depth to hard rock, content of stones and rocks, and wetness affect ease of excavation and amount of cut-and-fill needed to reach an even grade.

Playgrounds--Playgrounds are areas to be used intensively for baseball, football, badminton, and for other similar organized games. These areas are subject to intensive foot traffic. A nearly level surface, good drainage, and a soil texture and consistency that gives a firm surface generally are required. Soil suitability for growing vegetation is an important consideration.

Paths and Trails--Paths and trails include local and cross-country footpaths, trails, and bridle paths. It is assumed that these areas will be used as they occur in nature and that little or no soil will be moved (excavated or filled). Soil features that affect traffica-bility, dust, design, and maintenance are given special emphasis. These include soil texture, wetness, slope, and coarse fragments.

Picnic Areas and Campgrounds--Picnic areas and campgrounds are areas used for tents and small trailers and the accompanying activities of outdoor living or for picnicking. Foot traffic and vehicle traffic are usually more intense on campgrounds than on picnic areas, but the

two require about the same kind of soil. Well-drained, moderately permeable to rapidly permeable, nearly level soils with texture that provides a firm surface are ideal for picnic areas and campgrounds. Soils that have a high clay content, those that are very slowly permeable to water, those that have a water table within 20 inches of the surface during the season of use, or those that are on slopes of more than 15 percent are rated as severe. It is assumed that little site preparation will be done other than shaping or leveling for tents and parking areas. Soils should be suitable for heavy foot traffic and limited vehicular traffic. Suitability for growing vegetation is an important consideration.

Road Fill--The suitability ratings reflect (1) the predicted performance of soil after it has been placed in an embankment that has been properly compacted and provided with adequate drainage and (2) the relative ease of excavating the material at borrow areas.

Topsoil--Topsoil is used for topdressing an area where vegetation is to be established and maintained. Suitability is affected mainly by ease of working and spreading the soil material, as for preparing a seedbed; natural fertility of the material or the response of plants when fertilizer is applied; and absence of substances toxic to plants. Texture of the soil material and its content of stone fragments are characteristics that affect suitability, but also considered in the ratings is the damage that will result at the area from which topsoil is taken.

Dikes, Levees, and Embankments--Dikes, levees, and other embankments for retention of water require soil material resistant to seepage and piping and of favorable stability; shrink-swell potential; shear strength; and compactibility. Presence of stones or organic material in a soil are among factors that are unfavorable.

Drainage--Drainage is affected by such soil properties as permeability, texture, and structure; depth to claypan, rock, or other layers that influence rate of water movement; depth to the water table; slope, stability in ditch banks; susceptibility to stream overflow; salinity or alkalinity; and availability of outlets for drainage.

Irrigation--Irrigation of a soil is affected by such features as slope, susceptibility to stream overflow, water erosion or soil blowing, soil texture, contents of stones, accumulations of salts and alkali, depth of root zone, rate of water intake at the surface, permeability of soil layers below the surface layer, amount of water held available to plants, and need for drainage or depth to water table or bedrock.

Soil Series and Symbols	As A F:	Soil Features Affecting:		
	Topsoil	Dikes, Levees, Embankments	Drainage	Irrigation
Absarokee-(For Sinni see Sinni AbD	Fair 3,15	Low shear strength, fair compaction	Permeability is 0.2 to 0.6 in/hr. Hard sandstone at 20 to 40 in.	Permeability is 0.2 to 0.6 in/hr. Hard sandstone at 20 to 40 in.
Adel AdB	Fair 15	Low shear strength, fair compaction	Permeability is 0.60 to 2.0 in/hr.	Permeability is 0.60 to 2.0 in/hr.
Bearmouth (Mapped wi soils in	Poor 18	High permeability of the compacted soil	Permeability more than 6.0 in/hr below about 16 inches	Permeability more than 6.0 in/hr below about 16 inches
Bynum (Mapped wi in TbE)	Poor 4,5	Low shear strength, fair compaction	15 to 55 percent slopes water erosion hazard	15 to 55 percent slopes water erosion hazard
Castner (Mapped wi in WcE)	Poor 24	Fair compaction, medium piping hazard	Hard sandstone at 10 to 20 inches	Hard sandstone at 10 to 20 inches, low available water
Charlos [4] ChB	Fair 15	Medium or low shear strength, medium or high piping hazard	Permeability more than 6.0 in/hr below about 30 inches	Permeability more than 6.0 in/hr below about 30 inches
ChC	Fair 15	Medium or low shear strength, medium or high piping hazard	Permeability more than 6.0 in/hr below about 30 inches	Permeability more than 6.0 in/hr below about 30 inches
Grail GrB	Fair 15	Low shear strength, medium or low piping hazard	Permeability 0.20 to 0.60 in/hr, 4 to 8 percent slopes	Permeability 0.20 to 0.60 in/hr, 4 to 8 percent slopes
Havrelon [3] HaA	Good	Low shear strength, high piping hazard, fair or poor compaction	Permeability is 0.6 to 2.0 in/hr	Permeability is 0.6 to 2.0 in/hr
HaB	Good	Low shear strength, high piping hazard, fair or poor compaction	Permeability is 0.60 to 2.0 in/hr, 2 to 4 percent slopes	Permeability is 0.6 to 2.0 in/hr, 2 to 4 percent slopes
Larim LaB	Poor 18	Medium to high compacted permeability, medium piping hazard	Permeability is more than 20 in/hr, 0 to 8 percent slopes	Permeability is more than 20 in/hr, 0 to 8 percent slopes, more than 50 percent coarse fragments
Lohler [3] LoA	Poor 15	Low shear strength, fair or good compaction	Permeability is 0.2 to 0.6 in/hr	Permeability is 0.2 to 0.6 in/hr
LoB	Poor 15	Low shear strength, fair or good compaction	Permeability is 0.2 to 0.6 in/hr, 2 to 4 percent slopes	Permeability is 0.2 to 0.6 in/hr, 2 to 4 percent slopes

TABLE 6

TABLE OF SOIL INTERPRETATIONS FOR SELECTED USES[1/]

STILLWATER RIVER AND ROSEBUD CREEK FLOOD HAZARD ANALYSES

STILLWATER COUNTY, MONTANA

	Degree and Kind of Limitation For:										Suitability As A Source of:		Soil Features Affecting:		
Soil Series and Symbols	Cropland	Septic Tank Absorption Field	Sewage Lagoons	Shallow Excavations	Dwellings With Basements	Dwellings Without Basements	Local Roads Streets and Parking Areas	Playgrounds	Paths and Trails	Picnic Areas and Campgrounds	Road Fill	Topsoil	Dikes, Levees, Embankments	Drainage	Irrigation
Absarokee-Sinnigam (For Sinnigam part see Sinnigam) AbD	Moderate 3,8	Severe 8,22	Severe 3,22	Severe 22	Severe 22	Moderate 3,22	Moderate 3,22	Severe 3	Moderate 15,16	Moderate 3,15,16	Poor 22	Fair 3,15	Low shear strength, fair compaction	Permeability is 0.2 to 0.6 in/hr. Hard sandstone at 20 to 40 in.	Permeability is 0.2 to 0.6 in/hr. Hard sandstone at 20 to 40 in.
Adel AdB	Moderate 7,10	Moderate 7	Moderate 3,7	Slight	Moderate 11,13,20	Moderate 11,13,20	Moderate 11,13,20	Moderate 3,15,16	Moderate 15,16	Moderate 15,16	Fair 11,13,20	Fair 15	Low shear strength, fair compaction	Permeability is 0.60 to 2.0 in/hr.	Permeability is 0.60 to 2.0 in/hr.
Bearmouth [3/] (Mapped with Maurice soils in MbA)	Severe 6,18,21	Severe [2/] 1,6,17,21	Severe [2/] 1,6,17,21	Severe 18,19,21	Severe 1,21	Severe 1,21	Severe 21	Severe 21	Severe 21	Severe 21	Good	Poor 18	High permeability of the compacted soil	Permeability more than 6.0 in/hr below about 16 inches	Permeability more than 6.0 in/hr below about 16 inches
Bynum (Mapped with Thiel in ThE)	Severe 4,5	Severe 4,5,23	Severe 4,5	Severe 4,5	Severe 4,5	Severe 4,5	Severe 4,5	Severe 4,5	Moderate: 15 to 25 percent slopes Severe: 25 to 55 percent slopes	Severe 4,5	Good: 15 to 25 percent slopes Poor: 25 to 55 percent slopes	Poor 4,5	Low shear strength, fair compaction	15 to 55 percent slopes water erosion hazard	15 to 55 percent slopes water erosion hazard
Castner (Mapped with Wayden in WcE)	Severe 24	Severe 24	Severe 3,24	Severe 24	Severe 24	Severe 24	Severe 24	Severe 3	Slight	Moderate 3	Poor 24	Poor 24	Fair compaction, medium piping hazard	Hard sandstone at 10 to 20 inches	Hard sandstone at 10 to 20 inches, low available water
Charlos [4/] ChB	Severe 6	Severe [2/] 1	Severe [2/] 1,6	Severe 19	Severe 1	Severe 1	Moderate 11	Moderate 3,15,16	Moderate 15,16	Moderate 15,16	Fair 11,20	Fair 15	Medium or low shear strength, medium or high piping hazard	Permeability more than 6.0 in/hr below about 30 inches	Permeability more than 6.0 in/hr below about 30 inches
ChC	Moderate 3,6	Slight [2/]	Severe [2/] 6	Severe 19	Slight	Moderate 11	Moderate 11	Moderate 3,15,16	Moderate 15,16	Moderate 15,16	Fair 11,20	Fair 15	Medium or low shear strength, medium or high piping hazard	Permeability more than 6.0 in/hr below about 30 inches	Permeability more than 6.0 in/hr below about 30 inches
Grail GrB	Moderate 7,10	Severe 8	Slight 0 to 2 percent slopes Moderate 2 to 4 percent slopes	Slight	Moderate 13,20	Moderate 11,13,20	Moderate 11,13,20	Moderate 3,8,15,16	Moderate 15,16	Moderate 8,15,16	Fair 11,13,20	Fair 15	Low shear strength, medium or low piping hazard	Permeability 0.20 to 0.60 in/hr, 4 to 8 percent slopes	Permeability 0.20 to 0.60 in/hr, 4 to 8 percent slopes
Havrelon [3/] HaA	Slight	Severe 1	Severe 1	Slight	Severe 1	Severe 1	Moderate 11,20	Slight	Slight	Slight	Fair 11,20	Good	Low shear strength, high piping hazard, fair or poor compaction	Permeability is 0.6 to 2.0 in/hr	Permeability is 0.6 to 2.0 in/hr
HaB	Moderate 7,10	Moderate 7	Moderate 7	Slight	Slight	Moderate 11	Moderate 11,20	Moderate 3	Slight	Slight	Fair 11,20	Good	Low shear strength, high piping hazard, fair or poor compaction	Permeability is 0.60 to 2.0 in/hr, 2 to 4 percent slopes	Permeability is 0.6 to 2.0 in/hr, 2 to 4 percent slopes
Larim LaB	Severe 6,18	Slight [2/]	Severe [2/] 3,7	Severe 19	Slight	Slight	Slight	Severe 18	Severe 18	Severe 18	Good	Poor 18	Medium to high compacted permeability, medium piping hazard	Permeability is more than 20 in/hr, 0 to 8 percent slopes	Permeability is more than 20 in/hr, 0 to 8 percent slopes, more than 50 percent coarse fragments
Lohler [3/] LoA	Slight	Severe 2,8	Severe 2	Severe 15	Severe 1,14	Severe 1,14	Severe 14,20	Moderate 15,16	Moderate 15,16	Moderate 8,15,16	Poor 14,20	Poor 15	Low shear strength, fair or good compaction	Permeability is 0.2 to 0.6 in/hr	Permeability is 0.2 to 0.6 in/hr
LoB	Moderate 8,10	Severe 8	Moderate 3	Severe 15	Severe 14	Severe 14	Severe 14,20	Moderate 3,15,16	Moderate 15,16	Moderate 8,15,16	Poor 14,20	Poor 15	Low shear strength, fair or good compaction	Permeability is 0.2 to 0.6 in/hr, 2 to 4 percent slopes	Permeability is 0.2 to 0.6 in/hr, 2 to 4 percent slopes

TABL

Soil Se and Symbol	ty As A of: Topsoil	Soil Features Affecting: Dikes, Levees, Embankments	Drainage	Irrigation
Maurice MaA 3/	Poor 18	Medium or high compacted permeability	Seasonal water table at 24 to 36 inches	Seasonal water table at 24 to 36 inches
Maurice- (For Bea see Bea MbA 3/	Poor 18	Medium or high compacted permeability	Seasonal water table at or near the surface during summer	Seasonal water table at or near the surface during summer
Nunn NuA	Moderate 15	Low shear strength, fair compaction	Permeability is 0.2 to 0.6 in/hr	Permeability is 0.2 to 0.6 in/hr
Rentsac- (For Way see Way ReE	Poor 4,5, 18,24	Medium piping hazard, fair compaction	Hard sandstone at 10 to 20 inches, 15 to 50 percent slopes	Hard sandstone at 10 to 20 inches, 15 to 50 percent slopes
Rock Out Ro	Poor 5	Bedrock	Bedrock	Bedrock
Shane ShC	Poor 15	Low shear strength, high compressibility	Permeability is 0.06 to 0.20 in/hr, 4 to 8 percent slopes	Permeability is 0.06 to 0.20 in/hr, 4 to 8 percent slopes
Sinnigam (Mapped Absarok in AbD)	Poor 24	Medium or low shear strength, fair compaction	Hard sandstone at 10 to 20 inches, 8 to 15 percent slopes	Hard sandstone at 10 to 20 inches, 8 to 15 percent slopes
Sunup-Wa (For Way Wayden) SuE	Poor 4,5 18,24	Medium or high strength, medium piping hazard	Hard sandstone at 10 to 20 inches, 10 to 50 percent slopes	Hard sandstone at 10 to 20 inches, 10 to 50 percent slopes
Thiel-By (For Byn see Byn TbE	Poor 4,5,18	Medium or high compacted permeability	Permeability is 6.0 to 20.0 in/hr, 15 to 50 percent slopes	Permeability is 6.0 to 20.0 in/hr, 15 to 50 percent slopes
Typic Us TuA 3/				
Wanetta WaB	Fair 15	Medium or low shear strength, fair compaction	Permeability is 6.0 to 20.0 in/hr, 2 to 4 percent slopes	Permeability is 6.0 to 20.0 in/hr, 2 to 4 percent slopes
Wayden-C (For Cas see Cas WcE	Poor 4,5	Low shear strength, fair compaction	10 to 20 inches to rippable shale, 15 to 50 percent slopes	10 to 20 inches to rippable shale, 15 to 50 percent slopes
Work WoC	Fair 15	Low shear strength, fair compaction	Permeability is 0.60 to 2.0 in/hr, 2 to 8 percent slopes	Permeability is 0.60 to 2.0 in/hr, 2 to 8 percent slopes
WoD	Fair 3,15	Low shear strength, fair compaction	Permeability is 0.60 to 2.0 in/hr, 8 to 15 percent slopes	Permeability is 0.60 to 2.0 in/hr, 8 to 15 percent slopes

1/ All s more often than 100 years.
2/ Poten
3/ In so ded during the 100-year frequency flood.
4/ In so ng the 100-year frequency flood.

TABLE 6 — STILLWATER RIVER AND ROSEBUD CREEK FLOOD HAZARD ANALYSES (continued)

Soil Series and Symbols	Degree and Kind of Limitation For: Cropland	Septic Tank Absorption Field	Sewage Lagoons	Shallow Excavations	Dwellings With Basements	Dwellings Without Basements	Local Roads Streets and Parking Areas	Playgrounds	Paths and Trails	Picnic Areas and Campgrounds	Suitability As A Source of: Road Fill	Topsoil	Soil Features Affecting: Dikes, Levees, Embankments	Drainage	Irrigation
Maurice MaA 3/	Severe 6,18	Severe 2/ 1,2,17	Severe 2/ 1,2,6,17,18	Severe 2,18 19	Severe 1,2	Severe 1,2,11	Moderate 2	Severe 18	Severe 18	Severe 18	Good	Poor 18	Medium or high compacted permeability	Seasonal water table at 24 to 36 inches	Seasonal water table at 24 to 36 inches
Maurice-Bearmouth (For Bearmouth part see Bearmouth) MbA 3/	Severe 6,21	Severe 2/ 1,17,21	Severe 2/ 1,6,17,21	Severe 18,19,21	Severe 1,21	Severe 1,21	Severe 21	Severe 21	Severe 21	Severe 21	Good	Poor 18	Medium or high compacted permeability	Seasonal water table at or near the surface during summer	Seasonal water table at or near the surface during summer
Nunn NuA	Moderate 8,10	Severe 8	Slight	Slight	Moderate 13	Moderate 13	Moderate 13	Moderate 15,16	Moderate 15,16	Moderate 8,15,16	Poor 20	Moderate 15	Low shear strength, fair compaction	Permeability is 0.2 to 0.6 in/hr	Permeability is 0.2 to 0.6 in/hr
Rentsac-Wayden (For Wayden part see Wayden) ReE	Severe 4,5,6,24	Severe 2/ 4,5,24	Severe 2/ 4,5,6,24	Severe 4,5 19,24	Severe 4,5,24	Severe 4,5,24	Severe 4,5 24	Severe 4,5, 18,24	Moderate 15 to 25 percent slopes Severe 25 to 50 percent slopes	Severe 4,5	Poor 24	Poor 4,5, 18,24	Medium piping hazard, fair compaction	Hard sandstone at 10 to 20 inches, 15 to 50 percent slopes	Hard sandstone at 10 to 20 inches, 15 to 50 percent slopes
Rock Outcrop Ro	Severe 5	Severe 5	Severe 5	Severe 5	Severe 5	Severe 5	Severe 5	Severe 5	Severe 5	Severe 5	Poor 5	Poor 5	Bedrock	Bedrock	Bedrock
Shane ShC	Moderate 9,10	Severe 9	Moderate 3	Severe 15	Severe 14	Severe 14,20	Severe 14,20	Severe 15,16	Severe 15,16	Severe 15,16	Poor 14,20	Poor 15	Low shear strength, high compressibility	Permeability is 0.06 to 0.20 in/hr, 4 to 8 percent slopes	Permeability is 0.06 to 0.20 in/hr, 4 to 8 percent slopes
Sinnigam (Mapped with Absarokee soils in AbD)	Severe 24	Severe 24	Severe 3,24	Severe 24	Severe 24	Severe 24	Severe 24	Severe 3,24	Moderate 15,16	Moderate 15,16	Poor 24	Poor 24	Medium or low shear strength, fair compaction	Hard sandstone at 10 to 20 inches, 8 to 15 percent slopes	Hard sandstone at 10 to 20 inches, 8 to 15 percent slopes
Sunup-Wayden (For Wayden part see Wayden) SuE	Severe 4,5,10,24	Severe 4,5,24	Severe 3,4,5,24	Severe 4,5,24	Severe 4,5,24	Severe 4,5,24	Severe 4,5,24	Severe 3,4,5,24	Moderate 18, 15 to 25 percent slopes Severe 25 to 50 percent slopes	Severe 4,5	Poor 24	Poor 4,5 18,24	Medium or high strength, medium piping hazard	Hard sandstone at 10 to 20 inches, 10 to 50 percent slopes	Hard sandstone at 10 to 20 inches, 10 to 50 percent slopes
Thiel-Bynum (For Bynum part see Bynum) TbE	Severe 4,5,10	Severe 2/ 4,5	Severe 4,5	Severe 4,5,19	Severe 4,5	Severe 4,5	Severe 4,5	Severe 4,5,18	Moderate 18, 15 to 25 percent slopes Severe 25 to 50 percent slopes	Severe 4,5	Fair 15 to 25 percent slopes Poor 25 to 50 percent slopes	Poor 4,5,18	Medium or high compacted permeability	Permeability is 6.0 to 20.0 in/hr, 15 to 50 percent slopes	Permeability is 6.0 to 20.0 in/hr, 15 to 50 percent slopes
Typic Ustifluvents TuA 3/	Too variable to classify; on-site investigation needed.														
Wanetta WaB	Moderate 3,6	Slight 2/	Severe 6 2/	Severe 19	Moderate 13	Moderate 13	Moderate 13	Moderate 3	Slight	Slight	Fair 13	Fair 15	Medium or low shear strength, fair compaction	Permeability is 6.0 to 20.0 in/hr, 2 to 4 percent slopes	Permeability is 6.0 to 20.0 in/hr, 2 to 4 percent slopes
Wayden-Castner (For Castner part see Castner) WcE	Severe 4,5,25	Severe 4,5,25	Severe 4,5,25	Severe 4,5	Severe 4,5	Severe 4,5	Severe 4,5	Severe 4,5,25	Moderate 15 to 25 percent slopes Severe 25 to 50 percent slopes	Severe 4,5	Poor 5,20	Poor 4,5	Low shear strength, fair compaction	10 to 20 inches to rippable shale, 15 to 50 percent slopes	10 to 20 inches to rippable shale, 15 to 50 percent slopes
Work WoC	Moderate 3,7	Moderate 3,7	Moderate 3,7	Slight	Moderate 13	Moderate 13	Moderate 13	Moderate 3	Slight	Slight	Poor 20	Fair 15	Low shear strength, fair compaction	Permeability is 0.60 to 2.0 in/hr, 2 to 8 percent slopes	Permeability is 0.60 to 2.0 in/hr, 2 to 8 percent slopes
WoD	Moderate 3,7	Moderate 3,7	Severe 3	Moderate 3	Moderate 3,13	Moderate 3,13	Moderate 3,13	Severe 3	Slight	Moderate 3	Poor 20	Fair 3,15	Low shear strength, fair compaction	Permeability is 0.60 to 2.0 in/hr, 8 to 15 percent slopes	Permeability is 0.60 to 2.0 in/hr, 8 to 15 percent slopes

1/ All soils identified as having a potential flood hazard because of being in the 100-year frequency flood area require on-site inspection and more detailed study to determine flood frequencies more often than 100 years.
2/ Potential ground-water pollution hazard.
3/ In some places all or part of the delineated units identified as this soil are flooded by the 100-year frequency flood. See the flood plain map to determine which areas of this soil are flooded during the 100-year frequency flood.
4/ In some places part of the delineated units identified as this soil are flooded by the 100-year frequency flood. See the flood plain map to determine which areas of this soil are flooded during the 100-year frequency flood.

GLOSSARY

Available water capacity--Available water capacity is the amount of water held in the soil for plant growth after all free water has drained away. It is expressed in inches of water held per five-foot depth of soil.

Inches/60-inch Profile	Class
0 to 3	Very low
3 to 6	Low
6 to 9	Moderate
9+	High

Calcareous Soil--Soil containing sufficient calcium carbonate to effervesce visibly when treated with 0.1 normal hydrochloric acid.

Clay--As a soil separate, the mineral soil particles less than .002 millimeters in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay loam--A soil textural class; soil material that has 27 to 40 percent clay and 20 to 45 percent sand.

Erosion hazard--Relative susceptibility of the soil to the prevailing erosion agents of water and wind.

Fine sandy loam--A soil textural class; soil material that contains either 20 percent clay or less and the percentage of silt plus twice the percentage of clay exceeds 30, and 52 percent or more sand; or less than 7 percent clay, less than 50 percent silt, and between 43 and 52 percent sand.

Interpretation, Soil--The art and science of explaining the meaning or significance of basic soil information for alternative uses.

Loam--A soil textural class having 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand.

Loamy sand--A soil textural class having 25 percent or more very coarse, coarse and medium sand, and less than 50 percent fine or very fine sand.

Mapping Unit--It is composed of one or more soils having defined properties. Included are areas of other soils.

Permeability--The rate at which water will move downward through a saturated soil. Terms used to describe relative classes of soil permeability are as follows:

Class	Rate of Measurement Through Soil (Inches per hr.)
Very slow	Less than 0.06
Slow	0.06 to 0.20
Moderately slow	0.20 to 0.6
Moderate	0.6 to 2.0
Moderately rapid	2.0 to 6.0
Rapid	6.0 to 20
Very rapid	More than 20

Potential for Frost Action--Potential for frost action refers to the heaving of soils upon freezing as a result of the formation of ice crystals or lenses in the scil. This is verv noticeable in the spring when the freezing and thawing is the most intense. The intensity of the problem is associated with soil and drainage

characteristics. Values of high, moderate, and low are used to rate this soil hazard for soils with a potential for frost action.

Reaction--The degree of acidity or alkalinity of the soil, usually expressed as a pH value. The following reaction classes are recognized:

Slightly acid	pH 6.1 to 6.5
Neutral	pH 6.6 to 7.3
Mildly alkaline	pH 7.4 to 7.8
Moderately alkaline	pH 7.9 to 8.4
Strongly alkaline	pH 8.5 to 9.0

Runoff--The removal of water by flow over the surface of the soil. The amount and rapidity of surface runoff are affected by the texture, structure, and porosity of the surface layer, by the vegetative covering, by the prevailing climate, and by the slope. The rate of surface runoff is expressed as follows: ponded, very slow, slow, medium, rapid, and very rapid.

Sand--Individual rock or mineral fragments having diameters ranging from 0.05 millimeters to 2.0 millimeters. Sand grains consist chiefly of quartz, but they may be of any mineral composition. As a textural class, soil that is 85 percent or more sand and not more than 10 percent clay.

Series, soil--A group of soils developed from a particular type of parent material and having genetic horizons that, except for texture of the surface soil, are similar in differentiating characteristics and in arrangement in the profile.

Shrink-swell potential--Shrink-swell potential is the potential volume change of a wet soil compared to the same soil when dry. The volume change behavior of soils is influenced by the amount and kind of clay present in the soil. In general, soils of clay texture have a high shrink-swell potential, whereas soils having high sand and gravel content with small amounts of clay and silt have a low shrink-swell potential.

Silt loam--A soil textural class; soil material that has 50 percent or more silt and 12 to 27 percent of clay.

Slope--The rise or fall of the land surface measured in feet per hundred feet distance and expressed in percent.

Soil, frigid--The mean annual soil temperature is 47°F (8°C) at a depth of 20 inches (50 cm).

Soil Series and Map Symbols--Each kind of soil is listed separately by series. The map symbol (such as Da) designates the mapping unit in which a given series occurs.

Soil, taxajunct--A soil that differs slightly from the named series by one or two features but does not change the use and management of the soil.

Subsoil--Technically, the B horizon; roughly, the part of the profile below plow depth.

Substratum--Any layer beneath the solum or true soil.

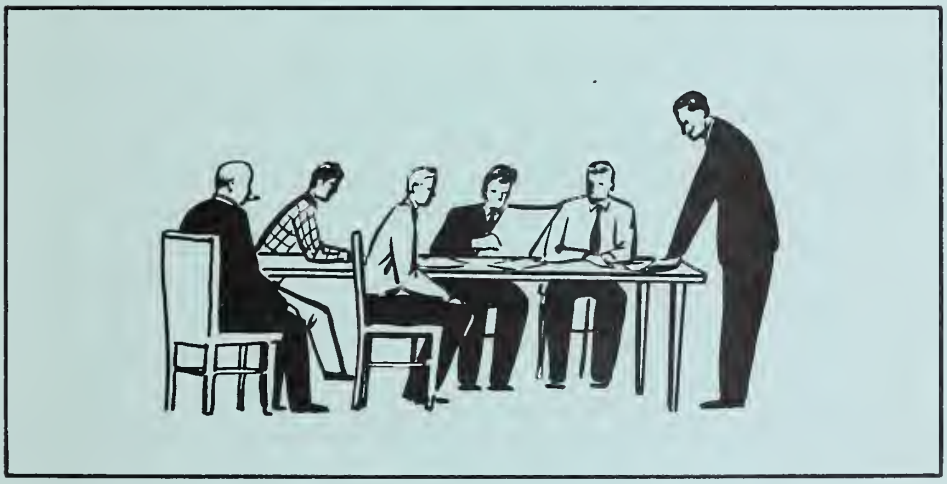
Surface Layer--The soil ordinarily moved in tillage or its equivalent in uncultivated soil (about 5 to 8 inches in thickness).

Terrace (Geologic)--An old alluvial plain, ordinarily nearly level or undulating, bordering a river or stream.

Texture, Soil--The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes used in this survey in order of increasing proportion of fine particles are loamy sand, loamy fine sand, sandy loam, fine sandy loam, loam, silt loam, sandy clay loam, clay loam, silty clay loam, silty clay, and clay. Gravelly and cobbly prefixes are added to the above textures when the percent by volume of these coarse fragments is 15 percent or greater.

APPENDIX C

Legal Reference



APPENDIX C-1

EXECUTIVE ORDER 11296

Executive Order 11296 is reproduced here in its entirety from the Federal Register, Vol. 31, No. 155, pp 10663-4--Thursday, August 11, 1966:

Title 3--THE PRESIDENT

Executive Order 11296

Evaluation of Flood Hazard in Locating Federally Owned or Financed Buildings, Roads, and Other Facilities, and in Disposing of Federal Lands and Properties

WHEREAS uneconomic uses of the Nation's flood plains are occurring and potential flood losses are increasing despite substantial efforts to control floods; and

WHEREAS national and regional studies of areas and property subject to flooding indicate a further increase in flood damage potential and flood losses, even with continuing investment in flood protection structures; and

WHEREAS the Federal Government has extensive and continuing programs for the construction of buildings, roads, and other facilities and annually disposes of thousands of acres of Federal lands in flood hazard areas, all of which activities significantly influence patterns of commercial, residential, and industrial development; and

WHEREAS the availability of Federal loans and mortgage insurance and land use planning programs are determining factors in the utilization of lands:

NOW, THEREFORE, by virtue of the authority vested in me as President of the United States, it is hereby ordered as follows:

SECTION 1. The heads of the executive agencies shall provide leadership in encouraging a broad and unified effort to prevent uneconomic uses and development of the Nation's flood plains and, in particular, to lessen the risk of flood losses in connection with Federal lands and installations and federally financed or supported improvements. Specifically:

(1) All executive agencies directly responsible for the construction of Federal buildings, structures, roads, or other facilities shall evaluate flood hazards when planning the location of new facilities and, as far as practicable, shall preclude the uneconomic, hazardous, or unnecessary use of flood plains in connection with such facilities. With respect to existing Federally owned properties which have suffered flood damage or which may be subject thereto, the responsible agency head shall require conspicuous delineation of past and probable flood heights so as to assist in creating public awareness of and knowledge about flood hazards. Whenever practical and economically feasible, flood proofing measures shall be applied to existing facilities in order to reduce flood damage potential.

(2) All executive agencies responsible for the administration of Federal grant, loan, or mortgage insurance programs involving the construction of buildings, structures, roads, or other facilities shall evaluate flood hazards in connection with such facilities and, in order to minimize the exposure of facilities to potential flood damage and the need for future Federal expenditures for flood protection and flood disaster relief, shall, as far as practicable, preclude the uneconomic, hazardous, or unnecessary use of flood plains in such connection.

(3) All executive agencies responsible for the disposal of Federal lands or properties shall evaluate flood hazards in connection with lands or properties proposed for disposal to non-Federal public instrumentalities or private interests and, as may be desirable in order to minimize future Federal expenditures for flood protection and flood disaster relief and as far as practicable, shall attach appropriate restrictions with respect to uses of the lands or properties by the purchaser and his successors and may withhold such lands or properties from disposal. In carrying out this paragraph, each executive agency may make appropriate allowance for any estimated loss in sales price resulting from the incorporation of use restrictions in the disposal documents.

(4) All executive agencies responsible for programs which entail land use planning shall take flood hazards into account when evaluating plans and shall encourage land use appropriate to the degree of hazard involved.

SEC. 2. As may be permitted by law, the head of each executive agency shall issue appropriate rules and regulations to govern the carrying out of the provisions of Section 1 of this order by his agency.

SEC. 3. Requests for flood hazard information may be addressed to the Secretary of the Army or, in the case of lands lying in the basin of the Tennessee River, to the Tennessee Valley Authority. The Secretary or the Tennessee Valley Authority shall provide such information as may be available, including requested guidance on flood proofing. The Department of Agriculture, Department of the Interior, Department of Commerce, Department of Housing and Urban Development, and Office of Emergency Planning, and any other executive agency which may have information and data relating to floods shall cooperate with the Secretary of the Army in providing such information and in developing procedures to process information requests.

SEC. 4. Any requests for appropriations for Federal construction of new buildings, structures, roads, or other facilities transmitted to the Bureau of the Budget by an executive agency shall be accompanied by a statement by the head of the agency on the findings of his agency's evaluation and consideration of flood hazards in the development of such requests.

SEC. 5. As used in this order, the term "executive agency" includes any department, establishment, corporation, or other organizational entity of the executive branch of the Government.

SEC. 6. The executive agencies shall proceed immediately to develop such procedures, regulations, and information as are provided for in, or may be necessary to carry out, the provisions of Sections 1, 2, and 3 of this order. In other respects this order shall take effect on January 1, 1967.

LYNDON B. JOHNSON

THE WHITE HOUSE
August 10, 1966

(F.R. Doc. 66-8838; Filed, Aug. 10, 1966; 12:14 p.m.)

APPENDIX C-2
EXCERPTS FROM:

National Flood Insurance Act of 1968 as Amended

Enacted by
HOUSING AND URBAN DEVELOPMENT ACT OF 1968
PUBLIC LAW 90-448
Approved August 1, 1968
and
HOUSING AND URBAN DEVELOPMENT ACT of 1969
PUBLIC LAW 91-152
Approved December 24, 1969

U.S. Department of Housing and Urban Development
Washington, D.C. 20410

(e) It is the further purpose of this title to (1) encourage State and local governments to make appropriate land use adjustments to constrict the development of land which is exposed to flood damage and minimize damage caused by flood losses, (2) guide the development of proposed future construction, where practicable, away from locations which are threatened by flood hazards, (3) encourage lending and credit institutions, as a matter of national policy, to assist in furthering the objectives of the flood insurance program, (4) assure that any Federal assistance provided under the program will be related closely to all flood-related programs and activities of the Federal Government, and (5) authorize continuing studies of flood hazards in order to provide for a constant reappraisal of the flood insurance program and its effect on land use requirements.

(f)[1] The Congress also finds that (1) the damage and loss which results from mudslides is related in cause and similar in effect to that which results directly from storms, deluges, overflowing waters, and other forms of flooding, and (2) the problems involved in providing protection against this damage and loss, and the possibilities for making such protection available through a Federal or federally sponsored program, are similar to those which exist in connection with efforts to provide protection against damage and loss caused by such other forms of flooding. It is therefore the further purpose of this title to make available, by means of the methods, procedures, and instrumentalities which are otherwise established or available under this title for purposes of the flood insurance program, protection against damage and loss resulting from mudslides that are caused by accumulations of water on or under the ground.

AMENDMENTS TO THE FEDERAL FLOOD INSURANCE ACT OF 1956

Sec. 1303.[2] (a) The second sentence of section 15 (e) of the Federal Flood Insurance Act of 1956 (79 Stat. 1078) is amended—

70 Stat. 1078.
42 USC 2414.

CHAPTER I—THE NATIONAL FLOOD INSURANCE PROGRAM

BASIC AUTHORITY

Sec. 1304. (a) To carry out the purposes of this title, the Secretary of Housing and Urban Development is authorized to establish and carry out a national flood insurance program which will enable interested persons to purchase insurance against loss resulting from physical damage to or loss of real property or personal property related thereto arising from any flood occurring in the United States.

(b) In carrying out the flood insurance program the Secretary shall, to the maximum extent practicable, encourage and arrange for—

(1) appropriate financial participation and risk sharing in the program by insurance companies and other insurers, and

(2) other appropriate participation, on other than a risk-sharing basis, by insurance companies and other insurers, insurance agents and brokers, and insurance adjustment organizations,

in accordance with the provisions of chapter II.

[1] Sec. 409 (a), Housing and Urban Development Act of 1969, Public Law 91—152, approved December 24, 1969, 83 Stat. 379, 397, added subsection (f).

[2] Sec. 1303 repealed all of the Federal Flood Insurance Act of 1956 except section 15 (e) of that Act which authorized borrowings from the United States Treasury for flood insurance purposes (se sec. 15 (e), infra). See also section 1309,infra.

SCOPE OF PROGRAM AND PRIORITIES

Sec. 1305. (a) In carrying out the flood insurance program the Secretary shall afford a priority to making flood insurance available to cover residential properties which are designed for the occupancy of from one to four families and business properties which are owned or leased and operated by small business concerns.

(b) If on the basis of—

(1) studies and investigations undertaken and carried out and information received or exchanged under section 1307, and

(2) such other information as may be necessary, the Secretary determines that it would be feasible to extend the flood insurance program to cover other properties, he may take such action under this title as from time to time may be necessary in order to make flood insurance available to cover, on such basis as may be feasible, any types and classes of—

(A) other residential properties,

(B) other business properties,

(C) agricultural properties,

(D) properties occupied by private nonprofit organizations, and

(E) properties owned by State and local governments and agencies thereof,

and any such extensions of the program to any types and classes of these properties shall from time to time be prescribed in regulations.

(c) The Secretary shall make flood insurance available in only those States or areas (or subdivisions thereof) which he has determined have—

(1) evidenced a positive interest in securing flood insurance coverage under the flood insurance program, and

(2) given satisfactory assurance that by December 31, 1971, adequate[3] land use and control measures will have been adopted for the State or area (or subdivision) which are consistent with the comprehensive criteria for land management and use developed under section 1361, and that the application and enforcement of such measures will commence as soon as technical information on floodways and on controlling flood elevations is available.

82 Stat. 574.
42 USC 4012.

NATURE AND LIMITATION OF INSURANCE COVERAGE

Sec. 1306. (a) The Secretary shall from time to time, after consultation with the advisory committee authorized under section 1318, appropriate representatives of the pool formed or otherwise created under section 1331, and appropriate representatives of the insurance authorities of the respective States, provide by regulation for general terms and conditions of insurability which shall be applicable to properties elegible for flood insurance coverage under section 1305, including—

(1) the types, classes, and locations of any such properties which shall be eligible for flood insurance;

(2) the nature and limits of loss or damage in any areas (or subdivisions thereof) which may be covered by such insurance;

(3) the classification, limitation, and rejection of any risks which may be advisable;

(4) appropriate minimum premiums;

[3] Sec. 410(a), Housing and Urban Development Act of 1969, Public Law 91-152, approved December 24, 1969, 83 Stat. 379, 397, substituted "December 31, 1971, adequate" for "June 30, 1970, permanent".

CHAPTER III--COORDINATION OF FLOOD INSURANCE WITH LAND-MANAGEMENT PROGRAMS IN FLOOD-PRONE AREAS

IDENTIFICATION OF FLOOD-PRONE AREAS

Contract authority

Sec. 1360. The Secretary is authorized to consult with, receive information from, and enter into any agreements or other arrangements with the Secretaries of the Army, the Interior, Agriculture, and Commerce, the Tennessee Valley Authority, and the heads of other Federal departments or agencies, on a reimbursement basis, or with the head of any State or local agency, or enter into contracts with any persons or private firms, in order that he may—

Publication of information.

(1) identify and publish information with respect to all flood plain areas, including coastal areas located in the United States, which have special flood hazards, within five years following the date of the enactment of this Act, and

Flood-risk zones.

(2) establish flood-risk zones in all such areas, and make estimates with respect to the rates of probable flood-caused loss for the various flood-risk zones for each of these areas, within fifteen years following such date.

CRITERIA FOR LAND MANAGEMENT AND USE

Sec. 1361. (a) The secretary is authorized to carry out studies and investigations, utilizing to the maximum extent practicable the existing facilities and services of other Federal departments or agencies, and State and local governmental agencies, and any other organizations, with respect to the adequacy of State and local measures in flood-prone areas as to land management and use, flood control, flood zoning, and flood damage prevention, and may enter into any contracts, agreements, or other appropriate arrangements to carry out such authority.

(b) Such studies and investigations shall include, but not be limited to, laws, regulations, or ordinances relating to encroachments and obstructions on stream channels and floodways, the orderly development and use of flood plains of rivers or streams, floodway encroachment lines, and flood plain zoning, building codes, building permits, and subdivision or other building restrictions.

82 Stat. 587. 42 USC 4102.

(c) On the basis of such studies and investigations, and such other information as he deems necessary, the Secretary shall from time to time develop comprehensive criteria designed to encourage, where necessary, the adoption of adequate[7] State and local measures which, to the maximum extent feasible, will—

(1) constrict the development of land which is exposed to flood damage where appropriate,

(2) guide the development of proposed construction away from locations which are threatened by flood hazards,

(3) assist in reducing damage caused by floods, and

(4) otherwise improve the long-range land management and use of flood-prone areas, and he shall work closely with and provide any necessary technical assistance to State, interstate, and local governmental agencies, to encourage the application of such criteria and the adoption and enforcement of such measures.

[7]Sec. 410(c), Housing and Urban Development Act of 1969, Public Law 91-152, approved December 24, 1969, 83 Stat. 379, 397, substituted "adequate" for "permanent".

PURCHASE OF CERTAIN INSURED PROPERTIES

Sec. 1362. The Secretary may, when he determines that the public interest would be served thereby, enter into negotiations with any owner of real property or interest therein which—

(1) was located in any flood-risk area, as determined by the Secretary,

(2) was covered by flood insurance under the flood insurance program authorized under this title, and

(3) was damaged substantially beyond repair by flood while so covered,

and may purchase such property or interests therein, for subsequent transfer, by sale, lease, donation, or otherwise, to any State or local agency which enters into an agreement with the Secretary that such property shall, for a period not less than forty years following transfer, be used for only such purposes as the Secretary may, by regulation, determine to be consistent with sound land management and use in such area.

CHAPTER IV—APPROPRIATIONS AND MISCELLANEOUS PROVISIONS

DEFINITIONS

82 Stat. 588.
42 USC 4121.

Sec. 1370. (a) As used in this title—

(1) the term "flood" shall have such meaning as may be prescribed in regulations of the Secretary, and may include inundation from rising waters or from the overflow of streams, rivers, or other bodies of water, or from tidal surges, abnormally high tidal water, tidal waves, tsunamis, hurricanes, or other severe storms or deluge;

(2) the terms "United States" (when used in a geographic sense) and "State" includes the several States, the District of Columbia, the territories and possessions, the Commonwealth of Puerto Rico, and the Trust Territory of the Pacific Islands;

(3) the terms "insurance company", "other insurer" and "insurance agent or broker" include any organizations and persons authorized to engage in the insurance business under the laws of any State;

(4) the term "insurance adjustment organization" includes any organizations and persons engaged in the business of adjusting loss claims arising under insurance policies issued by any insurance company or other insurer;

(5) the term "person" includes any individual or group of individuals, corporation, partnership, association, or any other organized group of persons, including State and local governments and agencies thereof; and

(6) the term "Secretary" means the Secretary of Housing and Urban Development.

"Flood"

(b)[8] The term "flood" shall also include inundation from mudslides which are caused by accumulations of water on or under the ground; and all of the provisions of this title shall apply with respect to such mudslides in the same manner and to the same extent as with respect to floods described in paragraph (1), subject to and in accordance

[8] Sec. 409 (b), Housing and Urban Development Act of 1969, Public Law 91-152, approved December 24, 1969, 83 Stat. 379, 397, added subsection (b).

UNITED STATES OF AMERICA,)
State of Montana) ss.

I, FRANK MURRAY, Secretary of State of the State of Montana, do hereby certify that the following is a true and correct copy of HOUSE Bill No. 924, Chapter No. 271, Montana Session Laws of 1974, enacted by the Second Regular Session of the Forty-third Legislative Assembly of the State of Montana, approved by Thomas L. Judge, Governor of said State, on the 21st day of March, 1974, and effective immediately.

IN TESTIMONY WHEREOF, I have hereunto set my hand and affixed the great Seal of said State.

Done at the City of Helena, the Capital of said State, this 27th day of March, 1974.

/s/Frank Murray

Frank Murray
Secretary of State

. . . . . .

CHAPTER NO. 271
MONTANA SESSION LAWS 1974
HOUSE BILL NO. 924

AN ACT AMENDING THE FLOODWAY MANAGEMENT AND REGULATION ACT, SECTION 89-3501 ET SEQ., R.C.M. 1947, TO PROVIDE FOR THE DESIGNATION OF FLOODPLAINS AND FLOODWAYS; TO SHORTEN TO SIX MONTHS THE TIME WITHIN WHICH A POLITICAL SUBDIVISION MAY ADOPT LAND-USE REGULATIONS; TO EMPOWER THE BOARD OF NATURAL RESOURCES AND CONSERVATION TO SHORTEN UPON NOTICE THE SIX-MONTH TIME PERIOD WHEN NECESSARY TO COMPLY WITH FEDERAL FLOOD INSURANCE REGULATIONS; AND TO ALLOW LOCAL POLITICAL SUBDIVISIONS TO ADOPT EXCLUSIVE FLOODPLAIN AND FLOODWAY LAND-USE REGULATION AND PERMIT SYSTEMS; AND PROVIDING AN EFFECTIVE DATE.

BE IT ENACTED BY THE LEGISLATURE OF THE STATE OF MONTANA:

Section 1. Section 89-3502, R.C.M. 1947, is amended to read as follows:

"89-3502. Policy and purposes. The policy and purposes of this act are to guide development of the floodway areas of this state consistent with the enumeratef findings; to recognize the right and need of watercourses to periodically carry more than the normal flow of water; to provide state co-ordination and technical assistance to local units in management of floodway areas; to co-ordinate federal, state and local management activities for floodway areas; to encourage local governmental units to manage flood-prone lands including the

adoption, enforcement and administration of land-use regulations and to provide the Montana water resources board with authority necessary to carry out a comprehensive floodway management program for the state.

Specifically, it is the purpose of this act to:

(1) restrict or prohibit uses which are dangerous to health, safety of property in times of flood or cause increased flood heights or velocities;

(2) require that uses vulnerable to floods, including public facilities which serve such uses, be provided with flood protection at the time of initial construction;

(3) develop and provide information to identify lands which are unsuited for certain development purposes because of flood hazard;

(4) distinguish between the land-use regulations applied to the designated floodway and those applied to that portion of the designated floodplain not contained within the designated floodway;

(5) apply more restrictive land-use regulations within the designated floodway;

(6) ensure that regulations and minimum standards adopted under this act, insofar as possible, balance the greatest public good with the least private injury."

Section 2. Section 89-3503, R.C.M. 1947, is amended to read as follows:

"89-3503. Definitions. As used in this act, unless the context otherwise requires:

(1) "A flood of one hundred (100) year frequency" means a flood magnitude expected to recur on the average of once every one hundred (100) years, or a flood magnitude which has a one percent (1%) chance of occurring in any given year;

(2) "Channel" shall mean the geographical area within either the natural or artificial banks of a watercourse or drainway;

(3) "Board" shall mean the board of natural resources and conservation;

(4) "Department" means the department of natural resources and conservation provided for in title 82A, chapter 15;

(5) "Designated floodway" shall mean a floodway whose limites have been designated and established by order of the board.

(6) "Designated floodplain" means a floodplain whose limits have been designated and established by order of the board;

(7) "Drainway" shall mean any depression two (2) feet or more below the surrounding land serving to give direction to a current of water less than nine (9) months of the year, having a bed and well-defined banks; provided, that in the event of doubt as to whether a depression is a watercourse or drainway, it shall be presumed to be a watercourse;

(8) "Flood" shall mean the water of any watercourse or drainway which is above the bank or outside the channel and banks of such watercourse or drainway;

(9) "Floodway" shall mean the channel of a watercourse or drainway and those portions of the floodplain adjoining the channel which are reasonably required to carry and discharge the flood water of any watercourse or drainway;

(10) "Floodplain" shall mean the area adjoining the watercourse or drainway which would be covered by the flood water of a flood of one hundred (100) year frequency;

(11) "Establish" shall mean construct, place, insert, or excavate;

(12) "Natural obstruction" shall mean any rock, tree, gravel, or analogous natural matter that is an obstruction and has been located within the floodplain or floodway by a nonhuman cause;

(13) "Artificial obstruction" shall mean any obstruction which is not a natural obstruction and includes any dam, wall, riprap, embankment, levee, dike, pile, abutment, projection, revetment, excavation, channel rectification, bridge, conduit, culvert, building, refuse, automobile body, fill, or other analogous structure or matter in, along, across, or projecting into any floodplain or floodway which may impede, retard or change the direction of the flow of water, either in itself or by catching or collecting debris carried by such water, or that is placed where the natural flow of the water would carry the same downstream to the damage or detriment of either life or property;

(14) "Owner" shall mean any person who has dominion over, control of, or title to an obstruction;

(15)"Political subdivision" shall mean any incorporated city or town or any county organized and having authority to adopt and enforce land-use regulations; and

(16) "Responsible political subdivision" means a political subdivision that has enacted land-use regulations in accordance with this act.

(17) "Watercourse" shall mean any depression two (2) feet or more below the surrounding land serving to give direction to a current of water at least nine (9) months of the year, having a bed and well-defined banks; provided, that it shall, upon order of the board, also include any particular depression which would not otherwise be within the definition of watercourse."

Section 3. Section 89-3504, R.C.M. 1947, is amended to read as follows:

"89-3504. Program for delineation of floodways -- floodway-encroachment lines -- land-use regulations. (1)(a) The board shall initiate a comprehensive program for the delineation of designated floodplains and designated floodways for every watercourse and drainway in the state. It shall make a study relating to the acquiring of flood data, and have authority to enter into arrangements with the United States geological survey, the United States army corps of engineers or any other state or federal agency for such acquisition.

(b) Before the board establishes by order a designated floodplain or a designated floodway, the department shall consult with the affected political subdivisions. Consultation shall include, but not be limited to, the following:

(i) specifically requesting that the political subdivisions submit pertinent data concerning flood hazards, including flooding experiences, plans to avoid potential hazards, estimates of economic

impacts of flooding on the community, both historical and prospective, and such other data as considered appropriate;

(ii) notifying local officials, including members of the county commission, city council and planning board, of the progress of surveys, studies and investigations and of proposed findings, along with information concerning data and methods employed in reaching such conclusions; and

(iii) encouraging local dissemination of information concerning surveys, studies and investigations, so that interested persons will have an opportunity to bring relevant data to the attention of the department.

(2) When sufficient data have been acquired, the board shall establish, by order, after a public hearing, the designated floodplain within which a political subdivision may establish land-use regulation. When sufficient data have been acquired, the board shall establish, by order, after a public hearing, the designated floodway within which a political subdivision may establish land-use regulation. These designations shall be based upon reasonable hydrological certainty. When the designated floodplain or the designated floodway has been established, the board shall furnish such data to officials of the political subdivision having jurisdiction over such areas together with a map outlining the areas involved, a copy of this act, adopted rules and regulations of the board, and suggested minimum standards. These standards, rules and regulations shall reflect gradations in flood hazard based on criteria as outlined in subsection (2) of section 89-3507 of this act. In adopting these standards, rules, and regulations, the board shall consider local input from the affected political subdivisions. The board shall record all designated floodplains or designated floodways established by it in the office of the county clerk and recorder of each county in which such floodplains or floodways are found. The board shall have the power to alter such floodplains or floodways at any later time, by order, after a public hearing if a re-evaluation of the then available flood data warrants it. Notice of any such hearing or order of the board establishing or altering any such floodplains or floodways shall be given by publishing such notice once each week for three consecutive weeks in a legal newspaper published or of general circulation in the area involved, the last publication of which shall be not less than ten (10) days prior to the date set for the hearing or the effective date of such order.

(3) Upon transmittal of the floodplain information to officials of a political subdivision, the political subdivision has six (6) months from the date of transmittal to adopt land-use regulations which meet or exceed the minimum standards of the board. If within the six (6) month period the political subdivision has failed to adopt the land-use regulations, the department shall enforce the minimum standards within the designated floodplain or the designated floodway as established by the board under subsection (2) of this section, and no artificial obstruction or nonconforming use shall be

established by any person within the designated floodplain or the designated floodway, unless specifically authorized by the board. When necessary for compliance with federal flood insurance requirements, the board may shorten the six (6) month period upon notification to the political subdivision and publication of a notice thereof in a newspaper of general circulation in the affected area once a week for three (3) consecutive weeks."

Section 4. Section 89-3505, R.C.M. 1947, is amended to read as follows:

"89-3505. Artificial obstructions and nonconforming uses as nuisances. Any artificial obstruction or nonconforming use in any designated floodplain or designated floodway enforced under section 89-3504, subsections (3) or (4) and not exempt under section 89-3506 of this act is hereby declared to be a public nuisance unless a permit has been obtained for such artificial obstruction or nonconforming use from the department or the responsible political subdivision."

Section 5. Section 89-3506, R.C.M. 1947, is amended to read as follows:

"89-3506. Establishment of artificial obstructions or nonconforming uses unlawful -- permitted open space uses -- prohibited nonconforming uses. (1) It shall be unlawful for a person to establish any artificial obstruction or nonconforming use within a designated floodplain or a designated floodway, without a permit from the department or the responsible political subdivision. This act shall not affect any existing artificial obstruction or nonconforming use established in the designated floodplain or designated floodway under section 89-3504, subsections (3) or (4); provided, that no person shall make nor shall any owner allow alterations of any artificial obstruction or nonconforming use within a designated floodplain or a designated floodway whether the obstruction proposed for alteration was located in the floodplain or floodway before or after the effective date of this act except upon express written approval of the department or the responsible political subdivision. Maintenance of an obstruction shall not be construed to be an alteration.

(2) The following open space uses shall be permitted within the designated floodway, to the extent that they are not prohibited by any other ordinance or statute, and provided they do not require structures other than portable structures, fill, or permanent storage of materials or equipment; (a) agricultural uses (b) industrial-commercial uses such as loading areas, parking areas, emergency landing strips (c) private and public recreational uses such as golf courses, tennis courts, driving ranges, archery ranges, picnic grounds, boat launching ramps, swimming areas, parks, wildlife management and natural areas, game farms, fish hatcheries, shooting preserves, target ranges, trap and skeet ranges, hunting and fishing areas, hiking and horseback riding trails (d) forestry, including processing of forest products with portable equipment (e) residential uses such as lawns, gardens, parking areas and play areas (f) excavations subject to the issuance of a permit under section 89-3507.

(3) Permits shall be granted for the following uses within that portion of the floodplain not contained within the designated floodway, to the extent that they are not prohibited by any other ordinance, regulation or statute:

(a) any use permitted in the designated floodway;

(b) structures, including, but not limited to, residential, commercial, and industrial structures, provided that:

(i) such structures meet the minimum standards adopted by the board;

(ii) residential structures are constructed on fill such that the lowest floor elevation (including basements) is two (2) feet above the one hundred (100)-year flood elevation;

(iii) commercial and industrial structures are either constructed on fill as specified in subparagraph (ii) above, or are adequately floodproofed up to an elevation no lower than two (2) feet above the one hundred (100)-year flood elevation. Such floodproofing shall be in accordance with the minimum standards adopted by the board.

(4) The following nonconforming uses shall be prohibited within the designated floodway: (a) Any building for living purposes or place of assembly or permanent use by human beings (b) any structure or excavation that will cause water to be diverted from the established floodway, cause erosion, obstruct the natural flow of water, or reduce the carrying capacity of the floodway (c) the construction or permanent storage of any object subject to flotation or movement during flood level periods."

Section 6. Section 89-3507, R.C.M. 1947, is amended to read as follows:

"89-3507. Permits for obstructions -- application -- factors considered -- fees. (1) The department or the responsible political subdivision shall have the power to issue permits for the establishment or alteration of artificial obstructions and nonconforming uses which would otherwise violate section 89-3506 of this act. The application for the permit shall contain such information as the department or the responsible political subdivision shall require, including complete maps, plans, profiles and specifications of the obstruction or use and watercourse or drainway.

(2) In passing upon such application, the department or the responsible political subdivision shall consider in accordance with the minimum standards established by the board (a) the danger to life and property by water which may be backed up or diverted by such obstruction or use, (b) the danger that the obstruction or use will be swept downstream to the injury of others, (c) the availability of alternate locations, (d) the construction or alteration of the obstruction or use in such a manner as to lessen the danger, (e) the permanence of the obstruction or use, and (g) such other factors as are in harmony with the purpose of this act. The department or the responsible political subdivision may make a part of such permit any reasonable conditions it may deem advisable. In order for the permit to continue to remain in force, the obstruction or use must be maintained so as to comply with the conditions and specifications of the permit.

(3) Permits for obstructions or uses to be established in the designated floodplain or designated floodway of watercourses must be specifically approved or denied within a reasonable time by the department or the responsible political subdivision; permits for obstructions or uses in the designated floodplains or designated floodways shall be conclusively deemed to have been granted sixty (60) days after the receipt of such application by the department or the responsible political subdivision, or after such time as the board or the responsible political subdivision notifies the applicant that the permit is denied. The responsible political subdivision shall send to the department a copy of each permit granted pursuant to this section.

(4) Every application for a permit shall be accompanied by a nonrefundable application fee of ten dollars ($10) which the state treasurer shall credit to the floodway obstruction removal fund."

Section 7. Section 89-3508, R.C.M. 1947, is amended to read as follows:

"89-3508. Powers and duties of board relative to obstructions. The powers and duties of the board relative to obstructions in a board floodway shall include the following:

(1) Where an obstruction to a designated floodway established under section 89-3504, subsections (2) or (4) has been created by fallen trees, silt, debris, wreckage, unanchored automobile bodies, and like matter, the board may, in its discretion, remove the obstruction, in which case the cost of removal shall be borne by the board; and

(2) Where, after investigation, notice, and hearing, an order has been issued to the owner of an obstruction not exempt under the provisions of section 89-3506 of this act for its removal or repair, and the order is not complied with within such reasonable time as may be prescribed, or if the owner cannot be found or determined, the board may make or cause such removal or repairs to be made, the cost of which shall be borne by the owner and shall be recoverable in the same manner as debts are now recoverable by law."

Section 8. Section 89-3509, R.C.M. 1947, is amended to read as follows:

"89-3509. Authority to enter and investigate lands or waters. The board, or the responsible political subdivision, or agents, surveyors, or other employees thereof, may make reasonable entry upon any lands and waters in the state for the purpose of making any investigation, survey, removal, or repair contemplated by this act. An investigation of any natural or artificial obstruction or nonconforming use shall be made by the board either on its own initiative, on the written request of any three (3) titleholders of land abutting the watercourse or drainway involved, or on the written request of any political subdivision."

Section 9. Section 89-3510, R.C.M. 1947, is amended to read as follows:

"89-3510. Obstructions exempt where drainage area is small. This act shall not extend to any obstruction in the floodplain or floodway of a watercourse or drainway where the drainage area above the same, either within or without the state, is less than twenty-five (25) square miles in extent, unless a particular watercourse or drainway is expressly declared to be within the coverage of this act by order of the board."

Section 10. Section 89-3511, R.C.M. 1947, is amended to read as follows:

"89-3511. Orders and rules -- judicial remedy. The board may issue such orders and rules as are necessary to implement the provisions of this act. If an order is issued to the owner of an artificial obstruction or nonconforming use not exempt under the provisions of section 89-3506 of this act for its removal or repair, such order shall not become effective less than (10) days after a hearing is held relating to such order. In addition to any requirement imposed by subsection (2) of section 89-3504 of this act, where any order is issued which affects with particularity the land adjacent to any watercourse or drainway, notice of the contents of such order and of any required hearing shall be mailed by the board to the titleholder of such land not less than ten (10) days before the effective date of such order, or, if there is a required hearing, to the titleholder of such land and to the owner of the artificial obstruction or nonconforming use not less than ten (10) days before the date of such hearing; provided, that such notice need not be given to the owner of the artificial obstruction or nonconforming use for an order issued pursuant to subsection (2) of section 89-3508 of this act if the owner cannot be found or determined. All orders and rules issued by the board shall be on file at the offices of the board and in the office of the county clerk of each county affected by such order or rule. Any person aggrieved by any order of the board issued under this act may appeal from such order to a court of competent jurisdiction within thirty (30) days after its effective date. In the event such an appeal is taken, enforcement of such order shall be stayed pending the outcome of such appeal. Service of notice of the appeal shall be made upon the director of the board."

Section 11. Section 89-3514, R.C.M. 1947, is amended to read as follows:

"89-3514. Permit construed as added requirement--exception--immunity. (1) The granting of a permit under the provisions of this act shall in no way affect any other type of approval required by any other statute or ordinance of the state, of any political subdivision or of the United States, but shall be construed as an added requirement; provided, that if a political subdivision enacts in harmony with the purposes of this act permit issurance ordinances, regulations or resolutions and land-use ordinances, regulations or resolutions which meet or exceed the minimum standards of the board, and if the administrative and enforcement procedures established for those ordinances, regulations, or resolutions are found acceptable by the board, no permit from the department is required; however, if the board determines that there is a failure by a political subdivision to comply with the intent, purposes and provisions of this act and the minimum standards adopted thereunder, the powers of the political subdivision may be suspended after hearing, and the minimum standards adopted by the board shall be enforced by the department until such time as the board determines that the political subdivision will comply. The grant or denial of a permit shall not have any effect on any remedy of any

person at law or in equity; provided, that where it is shown that there is a wrongful failure to comply with this act, there shall be a rebuttable presumption that the obstruction was the proximate cause of the flooding of the land of any person bringing suit.

(2) No action for damages sustained because of injury caused by an obstruction for which a permit has been granted under this act shall be brought against the state, the board, a member of the board, or its employees or agents. No provision of this act shall be construed as interfering in any way with the right of the United States to regulate interstate commerce or the navigable waters of the United States."

Section 12. This act is effective on its passage and approval.

HOUSE BILL NO. 924

APPENDIX C-4

(THESE PROPOSED RULES ARE SUBJECT TO CHANGE ON ADOPTION AND PUBLICATION OF OFFICIAL RULES WHICH CAN THEN BE OBTAINED FROM THE MONTANA DEPARTMENT OF NATURAL RESOURCES AND CONSERVATION.)

PROPOSED RULES IMPLEMENTING
THE MONTANA FLOODWAY MANAGEMENT AND REGULATION ACT

CHAPTER 14C

Sub-Chapter 1

Definitions

Section 36-2.14C(1)-S1400 Definition of Terms

Sub-Chapter 2

Floodplain and Floodway Delineations

Section 36-2.14C(2)-S1410 Floodplain Delineation

Section 36-2.14C(2)-S1420 Floodway Delineation

Sub-Chapter 6

Minimum Standards--Designated Floodways

Section 36-2.14C(6)-S1430 Uses Allowed Without Permits

Section 36-2.14C(6)-S1440 Uses Requiring Permits

Section 36-2.14C(6)-S1450 Prohibited Uses

Section 36-2.14C(6)-S1460 Flood Control Works--Permits

Sub-Chapter 10

Minimum Standards--Flood Fringe

Section 36-2.14C(10)-S1470 Allowed Uses

Section 36-2.14C(10)-S1480 Prohibited Uses

Sub-Chapter 14

Minimum Standards--Designated Floodplains

Section 36-2.14C(14)-S1490 Standards for Designated Floodplains (No Flood Elevation or Floodway Data Available)

Sub-Chapter 18

Floodproofing Requirements

Section 36-2.14C(18)-S14000 Floodproofing Requirements

Sub-Chapter 22

Regulation and Enforcement--Permits--
Environmental Impact Statements

Section 36-2.14C(22)-S14010 Local Regulation and Enforcement

Section 36-2.14C(22)-S14020 Department Regulation and Enforcement

Section 36-2.14C(22)-S14030 Permits

Section 36-2.14C(22)-S14040 Environmental Impact Statements

Sub-Chapter 1

Definitions

36-2.14C(1)-S1400 DEFINITION OF TERMS (1) In addition to the definition of terms contained in Section 89-3503 of the Act, and unless the context requires otherwise, in this chapter:

(a) "Act" means the Montana Floodway Management and Regulation Act as amended, Title 89, Chapter 35, R.C.M. 1947.

(b) "Flood fringe" means that portion of a designated floodplain outside the limits of a designated floodway.

(c) "Channelization project" means the excavation and construction of an artificial channel for purpose of diverting the entire flow of a watercourse or drainway from its established course.

(d) "Alteration" means any structural change or addition to an artificial obstruction that either increases the size of the obstruction or increases its potential flood hazard. Maintenance of an obstruction is not an alteration. However, the repair, reconstruction, or improvement of a structure, the cost of which equals or exceeds fifty (50) percent of the actual cash value of the structure either (1) before the improvement is started, or (2) if the structure has been damaged and is being restored, before the damage occurred, is an alteration and not maintenance.

(e) "Riprap" means stone, rock, concrete block, or analogous material that is placed along the banks or bed of a watercourse for the purpose of alleviating erosion.

(f) "Utility transmission line" means any wire, pipe, or conduit used to transport energy, liquid, or materials.

(g) "Responsible political subdivision" means a political subdivision that has received Board approval of its adopted land-use regulations and enforcement procedures in accordance with Section 89-3514 of the Act and Section 36-2.14C(22)-S14010 of these rules.

(h) "Permit issuing authority" means the responsible political subdivision, if any, or the Department if there is no responsible political subdivision.

Sub-Chapter 2

Floodplain and Floodway Delineations

36-2.14C(2)-S1410 FLOODPLAIN DELINEATION (1) All floodplain delineation studies, reports, and maps used by the Department and Board to establish designated floodplains shall be based upon a flood of one hundred (100) year frequency.

(2) The Department shall, at least three (3) weeks prior to any hearing held for the purpose of establishing a designated floodplain or floodway, furnish the affected political subdivisions a copy of a map showing the proposed designated floodplain or floodway together with a letter requesting the political subdivisions to furnish any pertinent data on flood hazard. The Department shall also issue news releases at least three (3) weeks prior to any hearing requesting the public to submit any available data concerning flood hazard, flood elevations, or the proposed designated floodplain or floodway boundaries.

(3) Each floodplain delineation study arranged by the Department will, insofar as time and funds permit, include a water surface profile showing the elevation of the flood of one hundred (100) year frequency and a suggested designated floodway. The Department will also utilize flood hazard maps and data provided by the U.S. Department of Housing and Urban Development for the Federal flood insurance program as a basis for establishing the designated floodplain and floodway. Such maps will delineate the boundaries of the flood of one hundred (100) year frequency but will not generally include flood elevations or floodway data. Designated floodplains established for areas where elevations and/or floodways are lacking shall be regulated in accordance with Section 36-2.14C(14)-S1490 of these rules.

36-2.14C(2)-S1420 FLOODWAY DELINEATION (1) The delineation of the designated floodway shall be based on the channel of the watercourse or drainway and those portions of the adjoining floodplain which are reasonably required to carry and discharge the flood of one hundred (100) year frequency without any measurable increase in flood heights. In areas having appreciable urban development on the floodplain, the outer boundary lines of the floodway may generally follow the riverward limits of development provided that:

(a) The calculated elevation of the flood of one hundred (100) year frequency would not be increased more than five-tenths (0.5) foot in any one reach or for the cumulative effect of several reaches of a watercourse as a result of the additional constriction of the floodway;

(b) Floodway lines are compatible with local land use plans; and,

(c) The flood fringe does not contain appreciable areas with flood velocities greater than three (3) feet per second or flood depths greater than three (3) feet.

(2) After the delineation of a suggested designated floodway by the Department, and prior to the public hearing to consider the floodway delineations, the Department shall meet with local governmental and planning officials to consider possible adjustments due to local land-use considerations. No adjustments in floodway width or location will be made, however, if such adjustments would increase flood heights beyond the permissible limits noted in subsection (1) of this section.

Sub-Chapter 6

Minimum Standards--Designated Floodways

36-2.14C(6)-S1430 USES ALLOWED WITHOUT PERMITS

(1) Section 89-3506(2), R.C.M. 1947, specifies that the following open space uses shall be allowed without a permit anywhere within the designated floodway, provided that they are not prohibited by any other ordinance or statute, and provided that they do not require structures other than portable structures, fill, or permanent storage of materials or equipment:

(a) Agricultural uses;

(b) Industrial-commercial uses, such as loading areas, parking areas, and emergency landing strips;

(c) Private and public recreational uses, such as golf courses, driving ranges, archery ranges, picnic grounds, boat-launching ramps, swimming areas, parks, wildlife management and natural areas, game farms, fish hatcheries, shooting preserves, target ranges, trap and skeet ranges, hunting and fishing areas, and hiking and horseback riding trails;

(d) Forestry, including processing of forest products with portable equipment; and,

(e) Residential uses, such as lawns, gardens, parking areas, and play areas.

(2) In addition to the uses specified in the preceding subsection, the following uses do not, in the judgment of the Board, endanger health or safety or cause increased flood heights, and shall thus be allowed without a permit in the designated floodway:

(a) Irrigation and livestock supply wells, provided that they are located at least five hundred (500) feet from domestic water supply wells; and,

(b) Fences, except permanent fences crossing channels.

36-2.14C(6)-S1440 USES REQUIRING PERMITS (1) In addition to the open space uses allowed under the previous section, the following nonconforming uses and artificial obstructions may be permitted within the designated floodway, subject to the issuance of a permit by the permit issuing authority:

(a) Excavation of material from pits or pools, provided that:

(i) a buffer strip of undisturbed land of sufficient width to prevent flood flows from channeling into the excavation is left between the edge of the channel and the edge of the excavation;

(ii) the excavation meets all applicable regulations of other state agencies; and,

(iii) excavated material is stockpiled outside the designated floodway.

(b) Railroad, highway, and street stream crossings, provided that the crossings are designed to offer minimal obstruction to flood flows.

(c) Limited filling for highway, street, and railroad embankments not associated with stream crossings, provided that:

(i) alternative transportation routes outside the designated floodway are not available; and,

(ii) such floodway encroachment is located as far from the stream channel as possible.

(d) Buried or suspended utility transmission lines, provided that:

(i) suspended utility transmission lines are designed such that the lowest point of the suspended line is at least six (6) feet higher than the elevation of the flood of one hundred (100) year frequency;

(ii) towers and other appurtenant structures are designed and placed to withstand and offer minimal obstruction to flood flows; and,

(iii) utility transmission lines carrying toxic or flammable materials are buried to a depth at least twice the calculated maximum depth of scour for a flood of one hundred (100) year frequency. The maximum depth of scour may be determined from any of the accepted hydraulic engineering methods, but the final calculated figure shall be subject to approval by the permit issuing authority.

(e) Storage of materials and equipment, provided that:

(i) the material or equipment is not subject to major damage by flooding and is properly anchored to prevent flotation or downstream movement; or,

(ii) the material or equipment is readily removable within the limited time available after flood warning. Storage of flammable, toxic, or explosive materials shall not be permitted.

(f) Domestic water supply wells, provided that:

(i) they are driven or drilled wells located on ground higher than surrounding ground to assure positive drainage from the well;

(ii) well casings are watertight to a distance of at least twenty-five (25) feet below the ground surface;

(iii) water supply and electrical lines have a watertight seal provided where the lines enter the casing; and,

(iv) all pumps and electrical lines and equipment are of the submersible type.

(g) Buried and sealed vaults for sewage disposal in recreational areas, provided that they meet applicable standards of the Department of Health and Environmental Sciences.

(h) Public or private campgrounds, provided that:

(i) access roads require only limited fill and do not obstruct or divert flood waters; and,

(ii) no dwellings or permanent mobile homes are allowed (camp trailers without wheels or towing vehicles or otherwise not quickly movable are considered permanent mobile homes).

(i) Structures accessory to the uses permitted in this subsection, such as boat docks, marinas, barns, sheds, permanent fences crossing channels, picnic shelters and tables, and toilets, provided that:

(i) the structures are not intended for human habitation;

(ii) the structures will have a low flood damage potential;

(iii) the structures will, insofar as possible, be located on ground higher than the surrounding ground and as far from the channel as possible;

(iv) the structures will be constructed and placed so as to offer a minimal obstruction to flood flows;

(v) the structures will be firmly anchored to prevent floatation; and,

(vi) service facilities within these structures, such as electrical, heating, and plumbing facilities, are flood-proofed in accordance with Section 36-2.14C(18)-S14000.

(j) All other nonconforming uses or artificial obstructions not specifically listed in this subsection.

(2) As provided in the Montana Water Use Act of 1973, Sections 89-880 and 89-892, R.C.M. 1947, all new surface water diversions and changes in place of diversion after July 1, 1973, require permits or approval, respectively, from the Department. Within designated floodways, the Department shall review each proposed diversion and change in place of diversion to determine if flood flows may be affected. If it appears that a proposed diversion or change in place of diversion may significantly affect flood flows, the Department may require the applicant to provide additional information and to apply for a permit with the permit issuing authority under the Floodway Management and Regulation Act. A permit under the Floodway Management and Regulation Act shall not be granted if, in the judgment of the permit issuing authority:

(a) The proposed diversion will increase the upstream elevation of the 100-year flood a significant amount (five-tenths [0.5]ft. or as otherwise determined by the permit issuing authority);

(b) The proposed diversion is not designed and constructed to minimize potential erosion from flooding; and,

(c) Any permanent diversion structure crossing the full width of the stream channel is not designed and constructed to safely withstand up to a flood of one hundred (100) year frequency.

(3) In addition to the requirements of the preceding subsections, a new artificial obstruction or nonconforming use may not be approved under this section if it will significantly increase the upstream elevation of the flood of one hundred (100) year frequency or significantly increase flood velocities.

36-2.14C(6)-S1450 PROHIBITED USES (1) The following artificial obstructions and nonconforming uses are prohibited within the designated floodway:

(a) Structures for human habitation or assembly, including mobile homes without wheels or towing vehicles or otherwise not readily movable;

(b) Commercial buildings (except those noted in subparagraph (i) of subsection (1) of Section 36-2.14C(6)-S1440;

(c) Solid waste disposal; and,

(d) Soil absorption sewage systems.

36-2.14C(6)-S1460 FLOOD CONTROL WORKS--PERMITS (1) Since structural flood control works often significantly obstruct and affect floodway flow capacity, the following flood control measures shall require permits from the permit issuing authority:

(a) Flood control levees or dikes if:

(i) the proposed levees or dikes are designed to safely convey a flood of one hundred (100) year frequency with no more than a five-tenths (0.5) foot increase in the 100-year flood elevation at any point on the designated floodway; and,

(ii) the proposed levees or dikes, except those to protect agricultural land only, are constructed at least three (3) feet higher than the elevation of the flood of one hundred (100) year frequency.

The permit issuing authority may establish either a lower or higher permissible increase in the elevation of the flood of one hundred (100) year frequency for individual levee projects, based on the following criteria:

(i) the estimated cumulative effect of other reasonably anticipated future permissible uses; and,

(ii) the type and amount of existing flood prone development in the affected area.

(b) Riprap, except hand placed, if:

(i) the riprap is designed to withstand a flood of one hundred (100) year frequency;

(ii) the riprap does not increase the elevation of the flood of one hundred (100) year frequency; and,

(iii) the riprap will not increase erosion upstream, downstream, or across stream from the riprap site.

(c) Channelization projects if they do not significantly increase the magnitude, velocity, or elevation of the flood of one hundred (100) year frequency downstream from such projects.

(d) Dams, provided that:

(i) they are designed and constructed in accordance with approved safety standards; and,

(ii) they will not increase flood damages downstream, either through operational procedures or improper hydrologic design.

Sub-Chapter 10

Minimum Standards--Flood Fringe

36-2.14C(10)-S1470 ALLOWED USES

(1) All uses allowed in the designated floodway without a permit under Section 36-2.14C(6)-S1430 shall also be allowed without a permit in the flood fringe. All uses allowed in the designated floodway subject to the issuance of a permit under Sections 36-2.14C(6)-S1440 and 36-2.14C(6)-S1460 shall also be allowed in the flood fringe subject to the issuance of a permit by the permit issuing authority. In addition, structures, including, but not limited to, residential, commercial, and industrial structures, and fill, shall be allowed by permit within the flood fringe subject to the following:

(a) Such structures or fill must not be prohibited by any other statute, regulation, ordinance, or resolution;

(b) Such structures or fill must be compatible with local comprehensive plans, if any;

(c) Residential structures must be constructed on fill such that the lowest finish-floor elevations (including basement) are two (2) feet or more above the elevation of the flood of one hundred (100) year frequency. The fill shall be at an elevation no lower than elevation of the flood of one hundred (100) year frequency and shall extend for at least fifteen (15) feet at that elevation beyond the structure in all directions. Where existing streets, utilities, or lot dimensions make strict compliance with this provision impossible, the permit issuing authority may authorize through the permit a lesser amount of fill or alternative flood proofing measures. A responsible political subdivision shall notify the Department and receive its approval prior to approving any lesser fill or alternative flood proofing for residential structures;

(d) Commercial and industrial structures must be either constructed on fill as specified in the preceding subparagraph or be adequately flood proofed up to an elevation no lower than two (2) feet above the elevation of the flood of one hundred (100) year frequency. Flood proofing shall be in accordance with Section 36-2.14C(18)-S14000 and shall further include the following:

(i) if the structure is designed to allow internal flooding of the lowest floor, use of the floor shall be limited to such uses as parking, loading areas, and storage of equipment or materials not appreciably affected by flood water. Further, the floors and walls shall be designed and constructed of materials resistant to flooding up to an elevation two (2) or more feet above the elevation of the flood of one hundred (100) year frequency; and,

(ii) structures whose lowest floors are used for purposes other than parking, loading, or storage of materials resistant to flooding shall be waterproofed up to an elevation no lower than two (2) feet above the elevation of the flood of one hundred (100) year frequency. Waterproofing shall include impermeable membranes or materials for floors and walls, and watertight enclosures for all windows, doors, and other openings. These structures shall be designed to withstand the hydrostatic pressures resulting from a flood of one hundred (100) year frequency.

(e) Roads, streets, highways, and rail lines shall be designed to minimize increases in flood heights. Where failure or interruption of transportation facilities would result in danger to the public health or safety, the facilities shall be located two (2) feet above the elevation of the flood of one hundred (100) year frequency; and,

(f) Public or private structures and facilities for liquid or solid waste treatment and disposal must be flood-proofed to insure that no pollutants enter flood waters. These facilities must be approved by the Department of Health and Environmental Sciences prior to any approval given by the permit issuing authority.

36-2.14C(10)-S1480 PROHIBITED USES (1) The following artificial obstructions and nonconforming uses are prohibited within the flood fringe:

(a) Solid waste disposal and soil absorption sewage systems, except as allowed or approved by the Department of Health and Environmental Sciences; and,

(b) Storage of highly toxic, flammable, or explosive materials. Storage of petroleum products may be allowed by permit if buried in tightly sealed and constrained containers, or if stored on compacted fill at least two (2) feet above the elevation of the flood of one hundred (100) year frequency.

Sub-Chapter 14

Minimum Standards--Designated Floodplains

36-2.14C(14)-S1490 STANDARDS FOR DESIGNATED FLOODPLAINS (NO FLOOD ELEVATION OR FLOODWAY DATA AVAILABLE)

(1) For those watercourses or drainways in which there is a designated floodplain, but not a designated floodway, or where no flood elevations are available, all uses allowed in a designated floodway under Section 36-2.14C(6)-S1430 without a permit shall also be allowed without a permit in such designated floodplain. All other uses within the designated floodplain shall require permits from the permit issuing authority. The following conditions, insofar as each is applicable, shall be attached to each permit approval:

(a) Proposed residential structures must be built on compacted fill such that finished first floor elevations are above the highest known historical flood elevation (if available);

(b) Any proposed construction must be designed and constructed to minimize possible flood damage;

(c) Proposed structures must be anchored to prevent flotation or collapse and must be located as far from stream channels as is practicable;

(d) Sanitary sewage systems must be approved by the Department of Health and Environmental Sciences prior to any approval given under these rules.

(2) Where a proposed development within such designated floodplain may significantly increase flood velocities or depths, the permit issuing authority may require a permit applicant to furnish additional hydraulic and survey information before acting upon the permit application. This information may include, but not be limited to, any of the following:

(a) Valley cross sections of the watercourse and adjoining floodplain;

(b) Certification by a qualified professional engineer that floodproofing measures are reasonably adequate to protect against major flood damages; or,

(c) A hydrologic study documenting probable effect on upstream or downstream property owners.

(3) Permits for such proposed developments may be modified or denied if the additional information shows that proposals would increase flood damages to other properties or would cause a threat to the health or safety of its occupants.

Sub-Chapter 18

Floodproofing Requirements

36-2.14C(18)-S14000 FLOODPROOFING REQUIREMENTS

(1) All electrical service materials, equipment, and installation for uses permitted with or without a permit in a designated floodplain or floodway shall conform to the following:

(a) All incoming power service equipment, including all metering equipment, control centers, transformers, distribution and lighting panels, and all other stationary equipment must be located at least two (2) feet above the elevation of the flood of one hundred (100) year frequency;

(b) Portable or movable electrical equipment may be placed below the elevation of the flood of one hundred (100) year frequency, provided that the equipment can be disconnected by a single plug-and-socket assembly of the submersible type;

(c) The main power service shall have automatically operated electrical disconnect equipment or manually operated electrical disconnect equipment located at an accessible remote location outside the designated floodplain and above the elevation of the flood of one hundred (100) year frequency; and,

(d) All electrical wiring systems installed below the elevation of the flood of one hundred (100) year frequency shall be suitable for continuous submergence and may not contain fibrous components.

(2) Heating systems for permitted floodplain and floodway uses shall conform to the following:

(a) Float operated automatic control valves must be installed in supply lines to gas furnaces, so that the fuel supply is automatically shut off when flood waters reach the floor level where the furnaces are located;

(b) Manually operated gate valves that can be operated from a location above the elevation of the flood of one hundred (100) year frequency shall also be provided in gas supply lines; and,

(c) Electric heating systems must be installed in accordance with subsection (1) of this section.

(3) Plumbing systems for permitted floodplain and floodway uses shall conform to the following:

(a) Sewer lines, except those to buried and sealed vaults, must have check valves installed to prevent sewage backup into permitted structures; and,

(b) All toilet stools, sinks, urinals, and drains must be located such that the lowest point of possible water entry is at least two (2) feet above the elevation of the flood of one hundred (100) year frequency.

Sub-Chapter 22

Regulation and Enforcement--Permits--
Environmental Impact Statements

36-2.14C(22)-S14010 LOCAL REGULATION AND ENFORCEMENT

(1) After a floodway or a floodplain has been designated by the Board, the Department shall notify the affected political subdivisions and set forth the date by which the political subdivisions must adopt land-use regulations in accordance with the Act and these rules.

(2) If a political subdivision adopts land-use regulations that equal or exceed the minimum standards contained in sub-chapters 6 through 18 of these rules within the time specified, and if the administrative and enforcement procedures for such regulations meet the requirements of these rules and are approved by the Board in accordance with Section 89-3514 of the Act, no permit will be required from the Department. Copies of all regulations, resolutions, or ordinances proposed to be adopted by a political subdivision to meet the requirements of the Act and these rules shall be sent to the Department for approval by the Board. The Department will notify the political subdivision by letter of Board approval or disapproval.

(3) Land-use regulations adopted by a local political subdivision in conformance with the Act and these rules may include zoning, building code, and subdivision regulations adopted pursuant to other enabling statutory authority, such as Title 11, Chapters 27 and 38, and Title 16, Chapters 41 and 47, R.C.M. 1947, as well as permit regulations adopted under the authority given in Sections 89-3506 and 89-3507 of the Act.

(4) Any land-use regulations and procedures adopted to comply with the Act and these rules must include the following:

(a) Permits must be required prior to the establishment of any new artificial obstruction or nonconforming use requiring a permit under the Act or these rules, or for the alteration of any existing artificial obstruction;

(b) An official must be hired or appointed with the authority to review permit applications and proposed uses or construction to determine compliance with the Act, these rules, and the regulations adopted by the political subdivision;

(c) Regulations governing the granting of permits must be at least as stringent as the minimum standards contained in these rules;

(d) The Department must be notified prior to the approval of any permit application that is in variance with the adopted regulations;

(e) Copies of all permits granted must be sent to the Department;

(f) All known property owners within the designated floodplain and designated floodway must be notified by certified mail by the political subdivision that their property is located within the designated floodplain or floodway and is subject to regulation. A list of all property owners so notified shall be sent to the Department;

(g) A disclosure provision requiring all property owners in a designated floodplain or floodway to notify potential buyers or their agents that such property is located within the designated floodplain or floodway and is subject to regulation.

(5) Permit regulations may also include the following:

(a) Requirements that existing nonconforming uses be inspected and documented to insure future compliance;

(b) The imposition of a reasonable fee, not to exceed twenty-five dollars ($25.00), for the processing of permit applications; and,

(c) The appointment or designation of a review board or board of adjustment to hear and decide upon appeals of decisions made by the political subdivision in the administration of the Act and its adopted land-use regulations.

36-2.14C(22)-S14020 DEPARTMENT REGULATION AND ENFORCEMENTS (1) If the political subdivision fails to adopt land-use regulations that meet or exceed the minimum standards required by the Act and these rules within the time specified, the minimum standards set forth in the Act and these rules regulating the designated floodplain or floodway will be enforced by the Department.

(2) An application to the Department for a permit shall be made on a standard form furnished by the Department (Form 650) and shall include all applicable information listed on the form.

(3) The permit to establish or alter artificial obstructions or nonconforming uses, if approved, will be given by the Department on a standard form (Form 651).

36-2.14C(22)-S14030 PERMITS (1) Permits shall be granted or denied by the permit issuing authority on the basis of whether the proposed establishment or alteration of an artificial obstruction or nonconforming use meets the minimum standards established by the Board in these rules. Additional factors that shall be considered for every permit application are:

(a) The danger to life and property from backwater or diverted flow caused by the obstruction;

(b) The danger that the obstruction will be swept downstream to the injury of others;

(c) The availability of alternative locations;

(d) The construction or alteration of the obstruction in such a manner as to lessen the danger;

(e) The permanence of the obstruction;

(f) The anticipated development in the foreseeable future of the area which may be affected by the obstruction; and,

(g) Such other factors as are in harmony with the purposes of the Act and these rules.

(2) The permit issuing authority may grant a permit for the establishment or alteration of an artificial obstruction or nonconforming use that is not in compliance with the minimum standards contained in these rules if:

(a) The proposed activity will not increase flood heights or flood hazard either upstream or downstream;

(b) Refusal of a permit would, because of exceptional circumstances, cause a unique or undue hardship on the applicant or community involved;

(c) The proposed use is adequately floodproofed; and,

(d) Alternative locations outside the designated floodway are not available.

(3) A permit application is considered to have been automatically granted sixty (60) days after receipt of the application, unless the permit issuing authority notifies the applicant before the sixtieth (60th) day that the permit is denied, or unless Section 36-2.14C(22)-S14040 applies.

36-2.14C(22)-S14040 ENVIRONMENTAL IMPACT STATEMENTS (1) If, in the case of a permit application to the Department, the Department is of the opinion that a proposed alteration, obstruction, or nonconforming use would have a significant impact on the environment, the Department may require the applicant to provide information necessary for the preparation of an Environmental Impact Statement, pursuant to the Montana Environmental Policy Act, Title 69, Chapter 65, R.C.M. 1947.

(2) If an Environmental Impact Statement is required, the Department shall so inform the applicant in writing, indicating the information required for preparation of the Environmental Impact Statement by the Department.

(3) A permit application requiring an Environmental Impact Statement will be specifically approved or denied by the Department only after full compliance with the provisions of the Montana Environmental Policy Act. Normally, the period of time required for review of these permit applications will be from sixty (60) to one hundred twenty (120) days.

APPENDIX C-5

EXCERPTS FROM HOUSE DOCUMENT NO. 465, A UNIFIED NATIONAL PROGRAM FOR MANAGING FLOOD LOSSES, 89th CONGRESS, 2d SESSION.

Page . . .34 and 35. . .

Under the Flood Insurance Act of 1956 the adoption of appropriate land use regulations would be a prerequisite for participation in any Federal flood insurance program.

Formal revisions of ordinances, regulations, and codes are not the only beneficial uses of flood data. Through the proper application of flood data, many municipal, industrial, commercial, and residential buildings have been located or planned so they will be reasonably free from flooding. Warnings to the public, such as signs and notices in newspapers or other news media, also are effective. But officials and individuals need guidance in interpretation of flood data and its application to decisions as to alternate plans for locating and designing major structures. Understanding of the flood hazard and of alternate methods of overcoming that threat must reach into the local governments and major corporations planning new developments. The resultant benefits of such a service may rival those resulting from official regulation.

(c) Regulation of land use.--Limited technical assistance and encouragement should be given State and local planners and officials and individuals in the preparation of flood plain regulation and the application of flood data for assessing flood plain location. Preliminary reports should be prepared for guidance in areas where assistance is needed before a full flood hazard information report can be prepared or where a full report is not scheduled. A closer relationship should be established between the Federal regional offices and those of the respective States and local communities. The Corps of Engineers under the guidance of the Water Resources Council should have the primary responsibility for this and should establish criteria and guides in cooperation with the Department of Agriculture and the Department of Housing and Urban Development. The annual cost of the service covering requirements of all participant agencies is estimated at $3,750,000.

Flood proofing

Many thousands of structures, and unfortunately far too many public buildings, are located in areas susceptible to flooding. Flood control projects have protected some of these and have reduced the flood threat to others. However, the residual threat and the total threat to the remaining sites remain as major problems to the respective communities. Effects on exposed water supply and sewage disposal plants cannot be measured in terms of dollars alone but involve the health, safety, and welfare of thousands of citizens.

Experience and studies show that flood proofing warrants consideration as a possible alternative among the various adjustments to flood. It has special promise in situations where: moderate flooding with low-stage, low velocity, and short duration is experienced; the traditional type of flood protection is not feasible; individuals desire to solve their flood problems without collective action or where collective action is not possible; activities which demand riverine locations to function need some degree of protection; or a resource manager desires a higher degree of protection than that which is provided by a flood control project.

Flexibility is inherent in this approach. It can be used in conjunction with flood control projects, flood plain regulation, and flood insurance in order to reduce flood losses. It also can be used separately for partial or interim loss reduction.

SOIL CONSERVATION SERVICE
U.S. DEPARTMENT OF AGRICULTURE